ANNALS OF SURGERY

VOL. LII NOVEMBER, 1910 No. 5

ORIGINAL MEMOIRS.

ATONY OF THE BLADDER WITHOUT OBSTRUCTION OR SIGNS OF ORGANIC NERVOUS DISEASES.*

BY J. W. THOMSON WALKER, M.B., F.R.C.S.,

OF LONDON,

Assistant Surgeon to St. Peter's Hospital.

To the surgeon, atony of the bladder is a sufficiently familiar phenomenon. For clinical purposes such cases have hitherto been arranged in two well-defined groups, those in which the atony results from obstruction to the outflow, and those in which organic nervous disease is present to explain the want of contractile power of the bladder. To the former group belong cases of enlargement, simple or malignant, of the prostate, and stricture; to the latter group, the cases of diseases of the spinal cord when the nervous control of the bladder has become early and severely affected. These cases usually drift to the surgeon under mistaken diagnoses of stricture or some form of obstructive diseases. Then there is another class of case of nervous disease, where the patient appeals to the surgeon for relief of secondary phosphatic stones in the bladder, or of chronic cystitis, resulting from

* A lecture delivered at the Medical Graduates College, London, on June 2, 1910.

repeated infection by means of the catheter. All these clinical types are familiar. I mention these two preliminary groups so that I may pass, with less fear of being misunderstood, to a third class of cases, which I now propose to discuss.

Such cases have atony of the bladder, but no obstruction to the outflow, and no signs of organic nervous disease can be discovered. Let me first relate a series of cases and then discuss them.

Case I.—J. M. (VI 575), a well-built man of twenty-eight years, a salesman, came under my care at St. Peter's Hospital in July, 1909, complaining of difficult micturition and nocturnal dribbling. He first noticed difficulty in micturition five or six years before I saw him. The onset was insidious, and the trouble gradually increased. Twelve months ago, he had large steel instruments ($^{13}/_{15}$) passed on several occasions at a general hospital, but without benefit.

For the last six weeks his water had dribbled away at night. He usually got up twice to pass it, but if he did not wake, his bed was soaked. He denied syphilis, but stated that he had an attack of gonorrhœa seven years ago.

When I examined him there was difficulty in starting micturition, and he frequently waited three or four minutes. The stream was slow and there was a good deal of after-dribbling. Large metal sounds ($^{14}/_{16}$) passed into the bladder without any difficulty. There was residual urine varying in amount from four to six ounces.

On cystoscopy, the whole bladder showed a very pronounced degree of trabeculation (Fig. 2). There was a thick interureteric bar. The ureteric orifices were normal. The mucous membrane was clear, the blood-vessels somewhat dilated, especially at the base. The urethral orifice showed no abnormality. I could find no evidence of nervous disease, and referred him to Dr. Purves Stewart, who reported that "his pupils, cranial nerves, sensory, motor, and reflex functions were all normal."

Case II.—G. W. B. (VII, 526), a wood machinist, aged thirty-seven, was brought to me by Dr. Robert Purdie. Fourteen years ago he began to have difficulty in passing water, and this had gradually increased. During the past four months there had been

a decided increase in the difficulty. There had never been complete retention. He denied venereal disease. He passed water only once a day, and not at all at night. Micturition was performed from a sense of duty, not from a natural desire. He had to wait for some minutes before the urine commenced to flow. The stream was small and feeble. It came in intermittent spurts induced by straining. About an ounce was passed at a time. He frequently had to wait for a quarter of an hour before the stream commenced again. There was some aching at the sacral base. There were no other urinary symptoms. The urine was clear, had a specific gravity of 1006, and contained no albumin. The bladder was distended almost to the level of the umbilicus. A pint of urine was removed, and the bladder was still palpable above the pubes. The prostate was normal in size, with a broad median sulcus. There was no stricture or other obstruction to the introduction of large instruments. Cystoscopy showed well-marked trabeculation of the bladder, which was most marked on the right side. The trabeculation extended to the apex, but was not so pronounced at the higher part of the bladder as at the base.

The orifice of a solitary small diverticulum with sharply cut edge was seen to the right and behind the right ureteric orifice. The trigone and ureteric orifices were normal. The urethral orifice was normal. I could find no evidence of nervous disease, and Dr. Purves Stewart confirmed this opinion.

Case III.—G. W. (VII, 141), a lamp-lighter, aged forty-one, came under my notice at St. Peter's Hospital in March, 1910, complaining of "stoppage of water." Four years ago he noticed that the stream was slow and small, and he made water "pretty frequently." Two years ago the difficulty increased, and he almost had retention, but it was not quite complete.

He had little desire to pass water, and would go all day from morning to night without attempting to do so. Usually, however, he passed water three or four times during the 24 hours, from the belief that it was proper for him to do so, but not from any desire.

There was a delay of a half to one minute in commencing micturition. The stream was poor, dropping, and intermittent. There was a good deal of after-dribbling. There was some aching in the right sacro-iliac synchondrosis, but he had no actual

pain. On one occasion he had passed some blood in the urine after a long bicycle ride.

He had lost flesh and strength during the last 18 months. He denied venereal disease. A year before I saw him, an instrument had been passed at two different hospitals under the impression that there was a stricture.

On examination the prostate was small and elastic, and nothing abnormal was detected by rectum. A large instrument was passed into the bladder without a hitch. There were 20 ounces of residual urine on one occasion and 22 on another. There was a moderate degree of trabeculation of the bladder and a small diverticulum was seen high up on the right wall. The prostate was not enlarged *per rectum* or intravesically. Dr. Purves Stewart reported, " I cannot find any evidence of organic disease in his nervous system."

Case IV.—H. S. (VI, 59), aged thirty-four, complained of frequent micturition and soaking the bed at night. He gave the following history: He contracted syphilis in 1895, and was treated for two years. He first noticed difficulty in micturition and increased frequency in 1898. The frequency amounted to six or eight times during the day and not at all at night, and this increased during these years to half-hourly frequency during the day and once at night. There was a difficulty in starting, and the patient had to wait some minutes before the flow commenced. He was admitted to St. Peter's Hospital in 1901 with these symptoms. The stream was intermittent and there was after-dribbling. Occasionally he had to go to stool to get the water to pass. No stricture was found, there was no residual urine, and the bladder, examined by the cystoscope, was healthy. " The cut off muscle was divided " by the surgeon in charge of the case and the patient was said to be relieved.

When I saw him in 1910, he still complained of difficulty in starting micturition and straining during the act. The flow was intermittent. It commenced with fair force, but gradually fell away into a dribble. When the bladder was full and he lifted a heavy weight or coughed, a little urine escaped; there was a slight escape from the rectum also at any undue muscular exertion. He had passed urine every hour and a half to two hours and had soaked the bed at night for the past 12 months. The prostate was not enlarged by rectum. The urethra admitted the

largest instruments without obstruction. There was moderate trabeculation of the bladder and some dilatation of the vessels at the trigone. There was no intravesical enlargement of the prostate. There were seven ounces of residual urine. There were nc signs of nervous disease.

CASE V.—J. G. C. (V, 533), a wireman, aged fifty-nine, was sent to me at St. Peter's Hospital in May, 1908, by Dr. C. W. Chapman. He was in good health until 18 months ago, when he showed symptoms of plumbism, for which he was treated.

He then came under Dr. Chapman's care for aortic and mitral lesions, and was sent to me on account of dribbling of his urine. He stated that four months before I saw him he had experienced scalding and great difficulty in passing water. Some time later he began to dribble at night, and this had continued. He passed water four or five times a day in a poor dropping stream. He had noticed a swelling of the abdomen for six weeks.

When I examined him the bladder was greatly distended and reached well above the level of the umbilicus. He suffered from thirst, headache, and a dry skin, and his appetite was poor. The tongue was dry. The prostate was small and soft. I admitted him to the hospital and his urine was slowly drawn off. There was no obstruction in the urethra. After the bladder had been emptied, the urine was drawn off twice daily. There was marked trabeculation of the bladder. The prostate did not project into the bladder. Dr. Purves Stewart found no organic nervous lesion.

CASE VI.—H. C. (V, 584), a laborer aged thirty-three, came under my observation at St. Peter's Hospital in May, 1908. He stated that he had suffered from difficulty in making water and some frequency for five years. The onset was gradual. Instruments were passed at a general hospital, but without any improvement in his symptoms. The frequency of micturition increased after this, and he passed water every quarter of an hour during the day, but not at all at night.

He was attended at St. Peters' Hospital in 1904, when it was noted that his urine was clear, with a few filaments. He passed water every hour and four or five times at night. Instruments were passed from time to time, but without improvement in his symptoms. In March, 1906, he was admitted to the hospital, and the urethra examined under an anæsthetic. Large steel instruments were passed, but no stricture was found.

I examined him in May, 1908. He complained of great difficulty in passing water. He had to wait some minutes before starting and strained during the act. So long as he kept straining with the abdominal muscles, the stream would flow, but whenever he ceased straining, the flow ceased.

At this time he passed water every two hours and not at all at night. The difficulty was increasing. From time to time he was unable to pass water at all, and he drew it off with a catheter. There was no obstruction to the passage of large instruments. The prostate was normal in size and consistence. There were ten ounces of residual urine. The bladder was trabeculated and the base rather puffy in appearance. No symptoms of nervous disease could be elicited.

CASE VII.—J. K. (VI, 129), a sweep, aged forty-six, came to me at St. Peter's Hospital in March, 1909, complaining of difficulty in micturition. He had noticed the difficulty for eight years, and it had gradually increased during that time. He also stated that he did not get an erection of the penis. When he attempted to pass water, he had to wait a minute or more before the flow commenced. The force was poor, the stream dropping down a foot in front of him. There was some after-dribbling. He passed water every hour during the day and three times at night. If he got excited, he felt an urgent desire to pass water, and had to pass it at once.

He had never had complete retention. The urine was clear, acid, and contained no albumin, mucus, or pus. The prostate was normal in size and consistence. There was no urethral obstruction. The bladder contained eight ounces of residual urine. It was slightly trabeculated, but otherwise healthy. No symptoms of nervous disease were elicited.

CASE VIII.—R. B. (VI, 364), aged thirty, came to my outpatient department at St. Peter's Hospital in January, 1909, complaining that his urine passed very slowly. I had examined him previously in August, 1907, when he stated that for 12 months he had experienced difficulty in starting micturition, and waited some seconds before the flow commenced. There was pain in the left groin on micturition. The urine was clear, there was no stricture and the prostate was normal.

In May, 1908, I again noted "difficult micturition, no stricture."

In January, 1909, he stated that the difficulty had increased.

He waited a minute before any urine appeared; the flow commenced gradually, the stream was poor, and dropped a few inches from the meatus, and finished up in a dribble. There was occasionally burning in the urethra after micturition. The urine was clear. He denied syphilis, but admitted an attack of gonorrhœa 26 years previously.

The urethra admitted large instruments without obstruction; the prostate was normal in size and consistence. There were four ounces of clear residual urine. The bladder showed trabeculation. No symptoms of organic nervous disease could be detected.

Case IX.—A. P. (VII, 479), a joiner, aged sixty, consulted me at St. Peter's Hospital in May, 1910, in regard to difficulty in micturition. He thinks he got a chill 12 months ago, and from that time the water passed slowly and with difficulty. This had been increasing, and three months ago he began to pass water at night. The water became thick six months ago and he once noticed some blood in it.

At the present time he waits half a minute before micturition commences; at first it dribbles and gradually gets a little stronger. At its height the stream is small and drops a few inches in front of the penis. It tails off into a dribble. There is suprapubic pain and pain to the right of the umbilicus on micturition. He is losing flesh a little. There is no history of stone or gravel. He denies syphilis, but states that he had one attack of gonorrhœa. The urine is cloudy with well-mixed pus and shreds. On examination the bladder was found to be distended to a little above the level of the umbilicus. The prostate was small and elastic. There was no obstruction to the passage of large instruments. The nervous system shows no sign of organic disease.

The nine cases that I have related fall under neither of the two preliminary categories into which cases of atonic bladder are ordinarily divided.

First, no evidence of obstruction could be obtained. The anterior urethra was examined in most of the cases with the urethroscope under air distention. In all of them large metal instruments were passed ($^{13}/_{15}$ to $^{15}/_{17}$), and the vesical orifice of the urethra was examined with the cystoscope. The rectal surface of the prostate was examined with the finger

and the vesical surface with the cystoscope. No abnormality was detected by these methods. Second, no signs of organic nervous disease could be elicited. In four of the cases I had the advantage of an opinion from Dr. Purves Stewart. In sifting the cases I have been particularly careful to exclude cases of early and irregular forms of disease of the spinal cord.

I shall now examine the characteristics of these nine cases. With two exceptions the symptoms commenced below the age of 40 years, and most were under 30 years (*22*, *23*, *37*, *22*, *57½*, *28*, *38*, *30*, *59*). There was a history of syphilis in two cases and of gonorrhœa in four others. The remaining three patients denied venereal disease. The common feature in all the cases was the gradual onset and increase of difficulty in micturition. The flow did not start promptly, there being a pause of some seconds or even minutes before the urine began to pass. The stream was feeble. It might commence with fair force, and then fall away into a dribble, or it might dribble at the start and gradually increase in strength and then relapse again into a dribble. It usually dropped a foot or so away from the patient. The stream was often intermittent—sometimes it was only projected at all by forced efforts of the abdominal muscles with a fixed diaphragm. At each respiration the flow ceased and recommenced as the diaphragm was again fixed and the compression renewed. The voluntary effort might be insufficient to start the stream at once, and in one instance the patient had to wait a quarter of an hour before the flow became re-established. At the end of micturition the stream again fell away into a dribble. In only one case had there been acute retention, and this recurred from time to time, and required the passage of a catheter.

Chronic distention of the bladder was present in four cases, the bladder reaching up to and above the umbilicus. In these cases the power of voluntary micturition remained, although greatly impaired. In the remaining cases residual urine was present and varied in amount from four to ten ounces. In one case there was an escape of urine on coughing and on any muscular effort. In this case, and in another, there was noc-

turnal dribbling from an over-distended bladder. In two cases the frequency of micturition was diminished. These patients informed me that they had no desire to pass water at any time. They might pass water once or twice in twenty-four hours, and if they did so oftener it was from a sense of fitness, not from any sensation of distention or of necessity. There were three patients who passed water more frequently than normal, as often as every hour during the day and several times at night. In two of these cases there was no question of the increased frequency being due to cystitis or other inflammation, for the increase had commenced spontaneously, before the passage of any instrument, and the urine was absolutely clear. In two of these cases there was no trace of inflammation in the bladder; in the third, the bladder base was somewhat puffy, and in this case there were a few filaments in clear urine. Any inflammation that might have been present in this case was insufficient to explain the frequency of micturition.

On cystoscopy there was in all these cases well-marked trabeculation of the bladder wall. This was usually general; sometimes one side was more trabeculated than the other, usually the trabeculation was less marked in the region of the apex than elsewhere. In three cases the trabeculation was extreme. In two less pronounced cases a solitary small diverticulum was present.

There was occasionally dilatation of the veins at the base of the bladder. The mucous membrane was clear and healthy in all except one case, where it was slightly puffy at the base. The ureteric orifices were normal. In one case the interureteric bar was thickened.

I shall now turn to discuss some points in regard to these cases.

1. What was the condition of the muscular apparatus of the bladder?

In dealing with the symptomatology, I have noted that the power of expelling the urine was diminished to a varying extent. This reduction of the effective power of the detrusor

muscle was measured by the manner in which the act of micturition was performed, and by the quantity of residual urine. The loss of power of the detrusor muscle usually commenced insidiously and was progressive; occasionally the onset was almost sudden and some amount of the power was regained. In one case the atony suddenly increased after being moderate for 14 years, so that the bladder became distended to above the level of the umbilicus. In another case there was a greatly distended bladder after 12 months, and in another after 18 months.

The condition of the muscular wall as shown by the cystoscope was very striking in all these cases. In all of them there was marked trabeculation, and in two the trabeculation was far in excess of anything that I have seen in other diseases of the bladder, of whatever nature. Where the trabeculation was moderate in degree it affected the lateral walls low down near the trigone, and to a less degree, the apex of the bladder. One side of the bladder might show trabeculation while the other was smooth. In some of the cases a tense, sharp band of muscle passed across a portion of the bladder wall and the wall above or below this was deeply hollowed. Where the trabeculation was present in a marked degree, it was universal, all parts of the bladder being affected, except the trigone, which remained unaltered. The larger muscle-bundles were sharply defined and widely separated. They stood out like round cords and branched into smaller strands, which disappeared in the general network. Between these larger bundles there were saucer-shaped depressions of varying depth, the walls of which showed fine secondary interlacing muscle-bundles.

The degree of trabeculation did not correspond to the amount of residual urine, nor to the duration of the symptoms. One patient with 20 ounces of residual urine, and symptoms which had lasted for 14 years, had a considerable degree of trabeculation most marked on the right side; another patient with an equal quantity of residual urine and symptoms for four years showed only slight trabeculation, while a third with four ounces of residual urine and symptoms for five or six years had universal trabeculation of an extreme degree.

Trabeculation has hitherto been regarded as a sign of hypertrophy of the bladder, and its presence has been looked upon as proof that obstruction to the outflow of urine was present. I have long suspected that there must be other factors in the causation of trabeculation of the bladder, which might act with obstruction or apart from it. In the first place I have frequently observed trabeculation of the bladder where obstruction to the outflow was certainly absent, where there was no difficulty in micturition, and where there was no obstruction to the introduction of full-sized instruments through the urethra. I should be departing too far from the object of this article were I to bring forward more than one case in support of this statement.

Let the following example suffice:

I saw F. M., a barrister, aged forty-six, in consultation with Dr. F. E. Batten. He gave the following history:

In May, 1909, he had an attack of hæmaturia following a game of golf, and there was some pain in the left side of the abdomen. The urine cleared and on examination contained hyaline and finely granular casts, a few red blood-corpuscles, renal cells, and calcium oxalate crystals. In November, 1909, he had an attack of renal colic on the left side, which lasted twelve hours. A radiogram showed a small calculus in the pelvic segment of the left ureter. He had no increased frequency until he was put on diuretics and large quantities of barley water, when he passed a good quantity of water every two hours, and rose once at night. There was no difficulty, pain, or discomfort on micturition. The prostate was normal in size and consistence, and there was no obstruction to the passage of large instruments. There was no residual urine. On cystoscopy the ureteric orifices were normal, and the mucous membrane of the bladder healthy. There was very marked trabeculation of the bladder, which was well distributed over the bladder. It was most marked at the base and at each lateral wall and not so marked at the apex. Dr. Batten assured me that there were no signs of organic disease of the nervous system. The trabeculation in this case was not due to hypertrophy produced by obstruction.

Nitze was the first to observe trabeculation of the bladder with the cystoscope in the early stages of tabes dorsalis, while Orth and others have described the condition post mortem in old-standing cases of tabes.

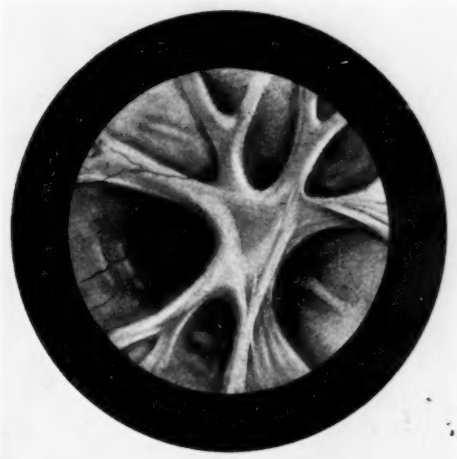
In an article on this subject Bohme[1] has described eight cases of tabes dorsalis in the early stage in which trabeculation of the bladder was present, and he looks upon this condition of the bladder as a diagnostic sign of tabes in the earliest stage. My own experience of the bladder in tabes is confined to 31 cases, nearly all of which were of the peculiar type in which the bladder is early affected whilst the other nervous symptoms are insignificant, and they usually came to me without any knowledge of their nervous disease. These cases correspond to those on which Bohme writes. In these cases some degree of trabeculation was usually present. It was, however, not infrequently absent, and in none of the cases was the degree of trabeculation so extreme as in two of the cases I have just described.

There is, therefore, I submit, a considerable body of evidence to show that trabeculation of the bladder may be observed in a pronounced degree quite apart from any of the gross forms of urethral obstruction with which we are familiar. There is a difference between this form of trabeculation and that which is observed in obstructive diseases. The trabeculation of an obstructed bladder is coarse, the muscular ridges thick and irregularly branching, and the interspaces deeply pouched; the openings of the saccules are often narrow (Fig. 1). In the trabeculated bladder without gross obstruction, the muscle ridges are fine and evenly set and the branchings regular and orderly (Fig. 2). Very fine twigs can frequently be seen branching and interlacing. The interspaces are not so deep and in my cases were usually saucer-shaped. The distribution of the trabeculation is also different. In the obstructed bladder the trigone is broken up into hypertrophied ridges. The ureteric bar is hidden among a number of thick trabeculæ, and it is often difficult to find the ureteric orifices. The rest of the bladder is also affected. In the unobstructed

FIG. 1.

Trabeculation of the bladder due to hypertrophy (case of enlargement of the prostate).

FIG. 2.



Trabeculation of the bladder due to atrophy (Case I).

trabeculated bladder, as Bohme has pointed out, the side walls and the apex of the bladder are affected, while the trigone escapes.

In the cases that I have just described the trabeculation was sometimes localized or more marked on one side than on the other. The area usually affected in such cases lay outside and behind the ureteric orifices and there might be a solitary area of trabeculation here while the rest of the bladder surface was unchanged. A solitary muscle band sometimes stood up strongly for a considerable distance. Such fine distinctions, while they do not invariably hold good, may certainly be recognized in the majority of cases.

Bohme adopts a theory which V. Frankl-Hochwart [2] advanced to explain difficult micturition and retention in disease of the spinal cord, namely, that the sphincter is unable to relax, and he looks upon the trabeculation in cases of tabes as due to this cause acting as an obstruction. According to this author, therefore, these tabetic bladders are to be ranged along with that of enlarged prostate and of stricture. I do not feel satisfied with this explanation. In one of my cases the bladder sphincter shared in the atony of the detrusor, for there was an escape of urine on coughing or on any muscular exertion, and in this case, with only seven ounces of residual urine, and another case, with from four to six ounces of residual urine, there was unconscious dribbling at night. Obstruction by the sphincter could, therefore, be excluded in these cases. The trabeculated bladder, which is not secondary to any of the tangible forms of obstruction, such as enlarged prostate or stricture, may be explained in another manner, if we can rid ourselves of the belief that trabeculation necessarily means hypertrophy. I would venture to suggest that the earliest change in these cases is atrophy, and that the prominence of some muscle-bundles is largely due to atrophy of the neighboring bundles. The greater calls that are made on the surviving bundles may be supposed to call forth a compensatory hypertrophy, but this is insufficient to do more than partly replace those that have atrophied. This suggestion fits in well

with the condition observed in cases of diseases of the spinal cord, for it is one of the characteristics of these cases that a considerable amount of improvement may take place in the muscular power of the bladder after the first few months or year of the atony.

2. What was the condition of the sensory apparatus of the bladder?

The sensibility of the bladder in these cases varied. In two cases it was certainly blunted, if not abolished. The patients felt neither the sharp sensation of the contact of urine with the mucous membrane of the prostatic urethra, nor the feeling of tension and weight above the pubes and in the perineum or penis that is experienced by normal individuals. These patients would go through the whole day without passing water and without discomfort. On the other hand, there were three cases where frequent micturition and urgency were prominent symptoms. In these cases the urine did not show evidence of cystitis, and the cystoscope displayed no inflammation. The mucous membrane of the bladder was undoubtedly hypersensitive in these patients. In the remaining cases there did not appear to be either diminution or increase in the sensibility of the bladder.

Every cystoscopist is familiar with the difficulty which a patient experiences in commencing micturition after the prostatic urethra and bladder-base have been rendered anæsthetic by means of cocaine instillation. The inability to pass water lasts a quarter or half an hour and then passes off as the effect of the drug disappears. While the prostatic urethra and bladder-base are still anæsthetic, it is often possible by a voluntary effort to start micturition, and, once started, the flow is sustained, with a force as great as in a normal individual. If micturition cannot be initiated and a catheter is passed, the fluid flows with as much force as where no anæsthetic has been applied. When urine has been passed voluntarily from a cocainized bladder, there is no residual urine left if none was present before the application of the anæsthetic. It therefore appears that anæsthesia of the bladder or of the prostatic

urethra, if judged by this standard, can only prevent the initiation of micturition, but does not affect the contraction of the bladder muscle once it is started.

Dr. Parkes Weber [3] has recorded an interesting case of paralysis of the bladder in a man aged 57 years. The patient was not aware whether his bladder was full or empty. Dr. Weber suggested that "a local hypo-anæsthesia (occurring as an early symptom of nervous disease) was an important factor in this retention of urine and vesical dilatation." This theory is inapplicable to the cases I have recorded, for the following reason: anæsthesia of the bladder, as I have pointed out, may prevent micturition by preventing its initiation, but once micturition is started, the stream is full and strong, and no urine is left behind as the result of the anæsthesia.

In my cases the stream was not merely delayed, as in cases of anæsthesia, but it was also feeble. Whether passed through the urethra or through a catheter, the want of force was obvious. Moreover, there was a quantity of residual urine in all the cases. If anæsthesia were the cause of the vesical inefficiency, there should have been an absence of initiation of the act and therefore complete retention and inability to micturate in all the patients, but this was not the case. And further, as I have shown, there was hyperæsthesia of the bladder in three cases.

3. The relation of these cases to vesical atony, secondary to obstruction.

Atony of the bladder, partial or complete, is most familiar to the surgeon as a result of gross enlargement of the prostate. It occurs also as a result of stricture of the urethra. Such lesions are readily demonstrated.

There is a class of cases that require more careful consideration, for they are more difficult to diagnose and exclude. I refer to cases where there is slight enlargement of the prostate, or atrophy of the prostate, or fibrous conditions at the internal meatus.

It is well known that enlargement of the prostate may produce sufficient obstruction to cause chronic retention of urine without any enlargement being detected on rectal exam-

ination. Such cases are not common, but they are of sufficiently frequent occurrence to receive general recognition. In these cases there is either a small pea- or cherry-like intravesical projection of the prostate or a prominent rim, at the back and sides of the internal urethral orifice, that has been aptly called a "collar-like" projection of the prostate. Such changes are recognizable by means of the cystoscope. They are evident when the bladder is opened above the pubes, and the orifice is inspected or palpated.

Another form of obstruction that cannot be recognized by rectal palpation is "contracture of the neck of the bladder." In this condition there is a fibrous thickening of the tissues around the internal meatus. It appears to result from old-standing inflammation, usually of venereal origin. There is obstruction at the entrance of the bladder to the passage of instruments. Stenosis of the orifice can also be detected by the finger introduced through a suprapubic cystotomy wound. With contracture of the neck of the bladder or apart from it, there may be atrophy of the prostate, which results from a similar cause. Atrophy of the prostate is easily recognized by the finger from the rectum.

Any of these conditions may cause obstruction to the outflow of urine, and they must therefore be carefully excluded by rectal palpation, by the passage of sounds, by cystoscopy, and if necessary, by suprapubic cystotomy.

In sifting my cases I have rigidly excluded all cases where abnormality of the prostate or prostatic urethra or vesical orifice of the urethra could be detected by any of these methods. The following case came under my care before I realized that there might be atony without obstruction or signs of nervous disease.

CASE X.—G. H. (1906, II, 246), a healthy man of sixty-three years, was admitted to St. Peter's Hospital with chronic retention and overflow.

Four years ago his urine began to dribble and his bladder was found to be distended. His doctor passed a catheter.

For three years he passed a catheter twice daily, and then

was advised to cease using the instrument with the result that he had pain and difficulty in micturition. The urine has been foul and there has been hæmaturia. When I examined him, he passed urine every two hours and rose once at night. There was urgency to pass urine, but he had to wait five minutes or more before the flow commenced. There was pain at the meatus before micturition, and scalding during and after the act. The stream was poor in force and small in volume, and sometimes stopped in the middle of the act. There were clots of blood in the urine. He had had an attack of gonorrhœa at the age of twenty years. No symptoms of organic disease of the nervous system could be elicited. The prostate was normal in size and consistence. There was a quantity of residual urine, which contained blood and mucopus. On cystoscopy there was cystitis and the bladder was trabeculated and there were sacculi. The prostate was not prominent in the bladder.

On August 1, 1906, the bladder was opened above the pubes and the prostate was examined. The prostate did not project into the bladder, and was small bimanually. Under the impression that I might have to deal with a case of contracture of the neck of the bladder, I forcibly dilated the prostatic urethra with my finger. Dr. Young of Baltimore was present at this operation, and suggested that a perineal prostatectomy should be done.

On August 30 the patient had recovered, but was entirely dependent on his catheter, passing no urine voluntarily. The urine was clear and without deposit.

On September 5 I performed perineal prostatectomy, dissecting away both lobes of the prostate. The patient was discharged on October 6 healed, and with clear urine, but absolutely dependent on his catheter.

From this case I learned that atony of the bladder might exist without signs of nervous disease, and be unrelieved by operation undertaken with a view to remove any possible obstruction.

4. The relation of these cases to tabes and other forms of disease of the spinal cord.

I have already referred to cases of early and irregular tabes as a cause of atony of the bladder and I do not intend to discuss these cases at present in detail. It is necessary, however,

to consider whether the cases I have described do not at a later period develop symptoms of tabes or other disease of the cord. None of these cases developed symptoms of disease of the spinal cord while they were under my observation. One might, I think, reasonably expect some symptoms of organic disease to develop in, say, three or four years after the bladder condition had become established. The following was the duration of the symptoms in these cases on the first occasion on which I examined them, and some of the patients have remained under my observation since: (1) five or six years, (2) fourteen years, (3) four years, (4) twelve years, (5) four months, (6) five years, (7) eight years, (8) two and one-half years, (9) three months.

I think there is here sufficient evidence to prove that these cases do not belong to the early and irregular forms of spinal disease.

Etiology and Nature of these Cases.—There is little information to be obtained from these cases in regard to etiology. So far as I could ascertain, only two patients had suffered from syphilis. One patient had had lead poisoning.

The reflex centre for the contraction of the bladder and the inhibition of the sphincter is placed, according to general belief, in the lumbosacral cord at the level of the third and fourth sacral segments. In diseases of the spinal cord, such as tabes, this centre is supposed to be affected, and atony of the bladder results as one of the symptoms of this disease. It is more difficult to explain the occurrence of disease confined to this centre affecting no other part of the cord.

Clinical and experimental researches by Goltz, Freusberg [4] and Ewald,[5] and C. R Müller [6] have shown that the lowest reflex centres, which control the functions of the bladder and rectum and the erection of the penis, are situated in the hypogastric and hemorrhoidal plexuses of the sympathetic. The cases that I have recorded are, I believe, to be explained by the existence of some lesion of this sympathetic reflex centre. This would explain the absence of symptoms of disease of the spinal cord which is a feature in these cases.

It is interesting to follow these cases into their later stages, and to note how secondary complications supervene and eventually conceal the original nature of the case. Without exhausting the resources of my clinic at St. Peter's Hospital, I have selected the following cases as representing the later stages of the disease.

CASE XI.—W. J. J., a journalist, aged fifty-three, was sent to me by Dr. J. M. H. MacLeod, complaining of thick urine. Eighteen years before I saw him, when thirty-five years of age, without apparent cause and without warning he suddenly lost the power of passing water. Since that time he had never passed urine voluntarily. All his urine was drawn off by catheter, which he passed himself without difficulty. His bladder became infected, and the cystitis varied in severity from time to time. He admitted one attack of gonorrhœa, but denied syphilis. When I examined him he was passing his catheter every two hours during the day and twice at night. The urine was foul and thick with shreds and mucopus. There was no obstruction to the passage of instruments through the urethra. The prostate was small but not atrophied. There were no signs of organic disease of the nervous system.

CASE XII.—W. E., a coachmaker, aged forty-three, complained of inability to pass water. The onset was gradual two years ago when there was difficulty in passing water. This increased until he could pass no water voluntarily, and was entirely dependent upon his catheter. He drew off the urine from four to six times during the day and four or five times at night. A small stone formed in a pouch in the bladder and was crushed and removed. The urine was thick, alkaline and stinking. There was no obstruction to the passage of instruments and the prostate was normal. The bladder was trabeculated and showed numerous saccules. There were no signs of organic nervous disease.

In the twelve cases here described, we have to deal with atony of varying degree. The urethra shows no sign of obstruction, and the prostate is healthy; there are no signs of organic disease of the nervous system. In a number of the cases the atony has been present for a sufficient period of time

to be certain that tabes or other disease of the spinal cord will not develop. There are acute and chronic cases. Such cases, I submit, form a class by themselves.

Literature.—There is little in the literature that bears directly on these cases. A few cases have been published, which appear to me to be similar in nature. Albarran and Noguès[7] have recorded two cases of retention of urine in young men, which they were unable to explain and could not classify. Mr. S. G. Shattock[8] described a post-mortem specimen of dilated bladder and ureters, and suggested that that condition was of "infantile origin" and analogous to idiopathic dilatation of the colon. The case may possibly belong to this group. I have already referred to a case recorded by Dr. Parkes Weber which he regarded as one of early nervous disease. It is possible that this case was similar to those described. Professor Casper[9] has recorded two cases of chronic retention of urine, one of which had signs of nervous disease and the other had none. The latter case appears to me to be similar to those I have described.

REFERENCES.

[1] Bohme: Münchener medicinische Wochenschrift, Dec. 15, 1908.
[2] Frankl-Hochwart: Handbuch der Urologie, v. Frisch und Zuckerkandl, B. 1, 1905.
[3] Parkes Weber: Practitioner, April, 1909.
[4] Goltz und Freusberg: Phlüger's Archiv., Bd. 8 und 9.
[5] Goltz und Ewald: Phlüger's Archiv., Bd. 63.
[6] Müller: Deutsche Zeitschrift für Nervenheilkunde, 1901, Bd. 21, S. 86.
[7] Albarran et Noguès: Primier Congrès de l'association internationale d'urologie, Paris, 1908.
[8] Shattock: Proceedings of the Royal Society of Medicine, vol. ii, 1909.
[9] Casper: Berliner klinische Wochenschrift, March 7, 1910.

CERTAIN CONGENITAL STRICTURES OF THE URETER.

BY JOHN T. BOTTOMLEY, M.D.,

OF BOSTON, MASS.,

Surgeon to Carney Hospital.

A CASE of congenital stricture of the ureter which came under our observation at the Carney Hospital led us to examine medical literature for pertinent information. To our surprise we found that the text-books of surgery either dismissed the subject with few words or said nothing at all of it. We could find but scant information (chiefly scattered reports of one or two cases) in English and American medical literature. A search of the German and the French, however, disclosed reports of several series of collected cases as well as interesting discussions of the general subject. Such information as we have been able to cull from these sources and from a study of additional cases will be set down in this paper. The subject in its entirety goes far beyond the limits of a single communication, and only that phase of it exampled by our own case will be treated herein.

Ureteral stricture may be congenital or acquired. Of the latter, which is the less frequent, we shall have nothing to say. We shall have to do only with congenital stricture and shall regard the word "stricture" in its wide sense, including in the term any narrowing of the ureter even up to complete impermeability, sharply localized narrowings as well as those which may include the whole or any part of the structure. In other words, we shall treat of congenital atresia (narrowing) of the ureter, partial, complete, or even accompanied by aplasia (imperfect development).

EMBRYOLOGY.

A grasp of the essential features of the embryonic development of the genito-urinary apparatus will enable us to understand better the possibilities arising from congenital faults,

and will determine more clearly the limits within which we propose to hold this discussion.

In early embryonic life the genito-urinary and the intestinal tracts have a common termination in the cloaca. The first rudiment of the permanent renal system (the ureter and the kidney) arises at the beginning of the second month of fetal life as an outgrowth with a narrow lumen from the dorsal side of the Wölffian duct, close to the termination of the latter in the cloaca. This outgrowth, the renal bud, the stalk of which represents the adult ureter, develops in a general upward direction and soon shows at its blind (upper) extremity a bifurcation, the forerunner of the adult renal pelvis; the two divisions of the bifurcation represent the chief renal calyces in the adult. The mesodermal tissue surrounding the bifurcation and its branches contributes to the formation of the adult renal parenchyma. In time the cloaca shows a tendency to differentiation, becomes smaller, and the common opening of the ureter and Wölffian duct is now in the bladder, to the formation of which the cloaca and allantois have contributed. In the further course of development the ureter and Wölffian duct begin to separate (from above downward), and the segment common to both finally disappears, the ureter and duct acquiring separate openings; these are at first close to each other, but subsequently, because of the enlargement downward of the space between them to form the prostatic urethra, they are far apart, the ureter terminating in the trigone of the bladder and the Wölffian duct (the future vas deferens, etc., of the adult) in the prostatic urethra as the ejaculatory duct. In the meantime, the cloaca as such has vanished and the hindgut has separated entirely from the anterior division. In the female the Wölffian duct practically disappears entirely; usually only an unimportant remnant remains in the broad ligament. Occasionally, however, it persists as a completely or partially open duct (Gärtner's duct) passing down in the superficial tissue of the cervix and vagina and terminating in the vulvar cleft at the outer side of the vaginal opening near the duct of Bartholin.[1] This is, of course, but a mere outline

of the story. To those interested in the detail of the embryologic development of the genito-urinary tract and in anomalies resulting from congenital defects and vagaries therein, Huntington's [2] Harvey lecture (upon which I have drawn for much of this paragraph) will be most attractive.

It is chiefly important for us to carry along three facts bearing on this phase of the subject, viz.: (1) the early common cloacal termination of the rudimentary genito-urinary and intestinal tracts and their subsequent complete separation; (2) the primary origin of the ureter from the Wölffian duct, which in the male represents the future vas deferens, ejaculatory duct, etc.; and (3) the early common opening of the ureter and Wölffian duct in the embryonic bladder and their later acquisition of separate openings, at first close together but finally far apart. Now with these facts in mind it is clear that an arrest or a failure or an imperfection of development may have to do with an ureter opening or evidently intended to open, (1) into the intestinal tract, or (2) into the genital tract, or (3) into (*a*) the bladder or (*b*), as a rare occurrence, elsewhere usually in connection with some persistent remains of the Wölffian duct. With the first two of these divisions the paper will not deal. It will be limited to a discussion of congenital strictures of such ureters as may be included under class *a* of the third division. Cases falling under class *b* have been reported by Förster,[3] Secheyron,[3] Vrolik,[3] Ortmann,[3] and Tangl.[4] Though they form an interesting series, no further consideration will be given them here, and only such congenitally strictured ureters as open, or were evidently intended to open, into the urinary bladder will be brought into question. Much that will be said of them would be equally true of such ureters opening into the intestinal or into the genito-urinary tract, but these divisions have sufficient matter peculiar to themselves to merit separate consideration.

ANALYSIS OF CASES REPORTED.

In 1896 Schwarz,[5] in the course of a long general article, reported 22 cases which come within the limits of this paper. To these Welz [6] added six cases in his Inaugural Address in

1903. Twenty-eight additional cases * (making a total of 56) will appear in this paper, 22 of them representing scattered, hitherto uncollected reports from medical literature. Six cases are reported here for the first time, one through the courtesy of Dr. E. H. Nichols of the Boston City Hospital, another (Case I) by the kind permission of Dr. E. Channing Stowell of the Massachusetts Infant Asylum, three others by courtesy of the Drs. Mayo, Rochester, Minn., and the sixth, a personal case from the surgical service of the Carney Hospital.

Of these 56 cases, 25 occurred in males, 16 in females, while in 15 cases (including monstrosities and pathologic specimens) no mention of sex was made. One would expect, however, that it would have no particular influence here.

A study of the ages shows that in some cases the defect is immediately incompatible with life, that in others it quickly develops to that stage of incompatibility, that in still others it remains latent in its effects till in some way infection starts up, and that in many it exists unsuspected during life and is found only at autopsy after death from other causes. To avoid tiresome figures, it may be said that a very striking feature is the number of cases discovered in subjects under five years of age and in those over sixty; in other words, at the extremes of life.

Forty-five cases had to do with single and 11 with supernumerary ureters. The left ureter was affected in 27 instances, the right in 17, both ureters in 10, and two reports fail to mention the side affected. Of the 11 supernumerary ureters, 6 were on the left side and 5 on the right; in 6 the upper ureter and in 3 the lower was affected. In 2 cases the supernumerary ureters merged into a common trunk near the bladder. All this is not entirely in agreement with Veau,[7] who speaks of the frequency of the congenital defect in connection with supernumerary ureters and asserts that the upper ureter is almost always affected.

* Since I had received the proof of this paper for correction, Dr. E. A. Codman, of Boston, called my attention to two cases which he had reported and which I had overlooked. These appeared in the Boston Medical and Surgical Journal of May 28, 1908, and of August 5, 1909.

ETIOLOGY.

The exact etiology of the defect is, of course, obscure. Men of equal repute sometimes hold diverse opinions as to the cause of certain features of the same case. It is generally agreed, however, that the malformation is the result of a primary defect, or of an arrest of an earlier embryonic stage, or of a secondary retrogressive metamorphosis. Mutach considered his case (Case XXVII) to be the result of an arrest of a fetal stage, contrary to the opinion of Virchow, who looked on it as the result of a past inflammatory process. Weigert believed that the cystic kidneys in his case (Case XXVI) were not the expression of a primary defect, nor of an arrest of development, but of an entirely secondary process. This seems reasonable, inasmuch as the upper portion of the ureter and the renal pelvis develop from and after the lower ureter, and in such a case as Weigert's the lower part of the ureter must have existed once and have been destroyed. Still, whatever the etiologic factors may be, our interest in them is only academic; for over them as causes we can have no control, and it is through their effects alone that they appear and appeal to us.

LOCATION AND RESULTS.

Now these effects are concerned with two factors, (*a*) the location and the form of the stricture, and (*b*) its after results.

The Location.—In several instances (Cases XXVI, XXXI, *v.g.*) a portion of the ureter was wholly fibrous, while in others (Cases XXVIII, XXXIII, XLIII, L, LI, *v.g.*) the ureter was impermeable throughout and was represented only by a fibrous cord—a functionless ureter. Teyssèdre[8] collected reports of 11 such cases. The further development of this defect leads to absence of the kidney and of the whole or a portion of the ureter. Teyssèdre reported 74 observations of this condition. In 8 cases of our series the stricture was located in the upper third of the ureter, usually at or close to

the opening into the renal pelvis. In 36 instances the obstruction was in or very close to the bladder. Nichols's case showed stricture both at the upper and at the lower end of the same ureter, and Allen and Parker's at the lower end of one ureter and at the upper end of the other. The same ureter may present alternating portions with and without a lumen (Case XXVII). However, leaving the great rarities aside, it is fair to assume that the ureter, if present, in the great majority of cases reaches the bladder and that the stricture is usually in or very close to that organ.

The Form.—This varies very much. It may be represented by a sharply defined narrowing (Cases XL, LIII), or may take the form of a section with a length varying from one-fourth inch to four inches of the calibre of a fine probe. The stricture may be passable or impassable.

The most important, and, in their effects, the most far-reaching modifications of form are seen in the obstructions at the lower end of the ureter. In these the ureter usually reaches the bladder and in most instances ends there in a blind sac. This blind end may be just beneath the mucous lining of the bladder, may lie in the muscular layer of the bladder wall, or may just reach the outer wall. If the blind end is in the muscular layer and one examines the bladder from within, either there will be no trace whatever of an ureteral opening, or in its place will be seen a dimple, a shallow invagination of the mucous membrane. If the blind end is just at or in the outer layer of the bladder wall (and this is a rather unusual occurrence), there may appear just above it a localized dilatation of the ureter which takes the form of a cyst just behind, *i.e.*, outside, the bladder (Cases XIX, XXII, XXXII). It is conceivable that this external pocket, if large, may compress the bladder, crowding in the posterior wall, or may, in women, even bulge the vesicovaginal septum.[9] In Case XIX, the cyst was as large as an egg. In some similar cases, this localized cyst-like formation does not take place, but the ureter becomes dilated throughout its length.

The most interesting forms, however, have to do with

the ureters ending just beneath the vesical mucous membrane. These produce a cyst-like protrusion of the mucous wall into the vesical cavity. The protrusions range in size from that of a small pea (Case V) to one completely filling the bladder (Cases XI and XIV); the smaller are usually hemispherical in shape; the larger are either triangular or finger-shaped, sometimes reach the vesical opening of the urethra, may pass varying distances along the course of the latter (Case XII), and in women may even appear at the external meatus (Cases VI, XIII, XVII). When empty, they are flat and flaccid; when full, are finger-like, pear-shaped, and tense, broader and thicker at the base, and gradually tapering and thinning in the direction of the tip. Occasionally one ends in a bulbous enlargement (Case VI). They exhibit lengths varying from 0.5 cm. (Case I) up to 6.5 cm. (Case IX). The diameter at the base varies from 2 cm. (Case XII) to 5 cm. (Case IX). They are lined on one side by the ureteral and on the other by the vesical mucous membrane. The ureteral opening into these pouches may be bristle-like or may be an aperture 2 cm. in diameter. In all Brinon's[10] observations the protrusion connected with an ureteral dilatation. Such a condition would be expected; for usually (in 12 out of 17 cases in this series) the protrusions are blind cul-de-sacs without an opening into the vesical cavity. In 5 cases there was a communication between the protrusion and the vesical cavity, almost invariably by minute openings at the tip or on the side of the former. A supernumerary ureter gave rise to this form of ending in 8 cases, a single ureter in 9 cases. It is usually unilateral, but Burckhard reports an instance (Case II) in which it was bilateral. The contents of the protrusions is usually a clear fluid; it may vary considerably in color in shades of brown and yellow. Sometimes a muddy or cloudy fluid is seen (Cases VIII and I).

Effect on Ureter.—When the obstruction is at the lower end, the ureter is almost invariably dilated, thin-walled, and tortuous. It varies in size from that of a pencil to that of the small intestine. Various observers use descriptive terms which

range from "dilated" to "tremendously" and "enormously dilated." It becomes widened and lengthened. Occasionally it is lobulated, shows windings and twistings, kinks and folds, and has been described as having "the appearance of a string of sausages." In such cases the wall on section is found to be thin and to show valve-like folds, which in places narrow the lumen. This may represent a persistence of the fetal type of ureter; for Hamann[11] finds that spindle-shaped dilatations and tortuosities of the ureter are nearly constant in the fœtus and therefore normal. Byron Robinson,[41] too, notes that all mammals possess ureteral dilatations and constrictions, which are, in his opinion, heritages from the Wölffian body, enhanced by environment, as erect attitude. It is an anatomic fact that where an ureteral constriction exists from heritage or is a pathologic condition, an ureteral dilatation will exist proximal to it.

In but three cases (Cases II, IX and XVI) is the ureteral wall described as "thickened," though Förster asserts that the walls keep their normal thickness or grow thicker. This was certainly not true of our own case. Intercurrent inflammatory processes, however, might produce such a condition. Shield (Case XXXVIII) reports an unusual case in which an enormously dilated ureter filled the whole pelvis with its distended coils, which pressed on the rectum and on the other ureter. In but one instance (Case XXVIII) in this series was mention made of the fat layer about the ureter and pelvis to the frequency of which Veau called attention. When there is a double ureter, the two, though usually in the same fibrous envelope, ordinarily follow separate paths. Veau, however, has often seen the dilated abnormal ureter twine about the healthy ureter. Förster relates what is probably a unique case (Case XLVIII) in which a much-dilated right ureter opened into the bladder on the left side. The effect of obstruction at the upper end of the ureter is too well known to deserve description here.

Effects on the Pelvis and Kidney.—Here the effects are striking; for either an enormous hydronephrosis or a most

marked primary atrophy may result from ureteral obstructions of the same location and character. It is only fair to state that, judging from a study of the present series, hydronephrosis of varying degree is the rule. It may show itself simply as a slight or a moderate distention of the pelvis, or it may present as an enormous cyst filling the whole abdominal cavity, with only remnants of the true kidney tissue in the cyst wall (Case XVI). Between these extremes many intermediate grades are seen. Infection, direct or indirect, produces its usual disastrous effects, and in some cases completely disorganized kidneys are found. In kidneys with supernumerary ureters, that half of the organ from which the affected ureter runs usually shows characteristic hydronephrotic changes, while the rest of the organ is normal. The only exception occurs when both ureters unite to form a common trunk after leaving the kidney.

Several cases (Cases VIII, XI, XXXIX, XLV, *v.g.*) of this series showed a marked degree of renal atrophy, the kidney in one case (XXXIX) being of the size of a bean. Study of these cases shows no sufficient reason why atrophy should have ensued rather than hypertrophy. Undoubtedly, some of the cases were examples of secondary atrophy, but a microscopic examination would probably have proven some of them to have been primary. Lindemann [12] produced complete exclusion of the ureter by ligature in six dogs, and in three simple primary atrophy of the kidney followed, while in three others simple hydronephrosis was the result. He concluded from a careful experimental study of the subject, that whether a primary atrophy of the kidney or an hydronephrosis develops in animals after ligature of the ureter depends on the grade of development of the compensatory anastomosis through the vessels of the capsule. The intrapelvic pressure following the ligature blocks the renal vessels coming in at the hilus, and the further effect of the ligature depends on the amount of blood the kidney substance can get through anastomosis between the kidney substance and its capsule. Kidney atrophy means a primary insufficiency of compensation through the

blood supply of the capsule. On the contrary, if the capsular blood supply is free, hydronephrosis will follow, and the fluid will accumulate again and again after tapping. Sollman, Williams, and Briggs,[13] in a series of experiments somewhat like Lindemann's, found hydronephrosis in every case (four dogs). Chemical examination of the fluid thus accumulating in the kidney showed it to be a transudate poor in proteids and chiefly noteworthy because of the absence of notable amounts of the specific urinary constituents. Complete ureteral obstruction, then, probably means rapid cessation of the true secretory function of the kidney; if a collection of fluid ensues, it is not urine but is a transudate (Case XI). Partial obstruction does not mean such cessation, and the resulting accumulation of fluid is an uronephrosis (Lindemann). Almost all cases of the present series showed what was practically a complete ureteral obstruction; the reports of such as showed partial obstruction contained no chemical study, and consequently no further information on this point can be drawn from them. In the light of our present knowledge it is very probable, however, that Burckhard's case (Case II) was one of uronephrosis rather than of hydronephrosis. The same is true of Drew's cases (XXXV, XXXVI). Lindemann's conclusion as to the occurrence of hydronephrosis and atrophy has been generally accepted.

Of course, in the above paragraph true primary atrophy of the kidney is meant in contradistinction to the atrophy secondary to hydronephrosis, which is a progressive pressure atrophy with flattening of the papillæ, obliteration of the uriniferous tubules and of the glomeruli which goes on till only a few remnants of kidney tissue remain flattened out in the wall of the cyst. Lindemann asserts that for true hydronephrosis persistence of the glomeruli is characteristic.

Several cases of the present series showed in place of the kidney only a conglomeration of cysts, several separate pockets. Whether they represent primary congenital defects or are the last stage of a secondary process is not apparent.

The kidney of the opposite side shows only hyperæmia and compensatory hypertrophy in the uncomplicated cases.

Effects on the Bladder.—The cystiform protrusions of the blind-ending ureter into the bladder may cause marked secondary pathologic changes in the bladder, in the other ureter, or in the other kidney. The protrusion from a supernumerary ureter may block the opening of the healthy ureter of the same side (Case I). The pocket may be so large as to block the ureteral opening of the other side. In other cases it may wholly obstruct the vesical opening of the urethra, give rise to a distended, hypertrophied bladder, and set going the usual sequelæ of retention of urine. Examples of all these possibilities are present in the appended abstract.

SYMPTOMS AND DIAGNOSIS.

In our series, 19 cases gave either subjective or objective symptoms, which may be attributed with fairness directly or indirectly to the congenital trouble. In 11 cases where one might expect symptoms, none were mentioned in the histories. This, of course, does not make first-class evidence; for most of the cases were reported more from the pathologic than from the clinical point of view. Many cases occurred in subjects too young to make complaints. On the other hand, Heller instances a case (Case XVI) of a seventy-nine year old woman who died of pneumonia, in whom autopsy disclosed an hydronephrosis practically filling the whole abdomen. Boström's case (Case XI) indicates that even a moderate protrusion into the bladder may exist for some years and be without symptoms. It is, of course, sufficiently evident that a strictured ureter on one side with a resulting renal atrophy or even with a moderate hydronephrosis might exist indefinitely without symptoms, if no intercurrent infection set in.

The symptoms, in such cases as gave any, varied much, and it is impossible to draw from them any picture that would definitely determine in future cases a diagnosis of congenital stricture. Some trouble with urination, usually frequency, is the most common complaint. Cases VII and LI, and one of

Mayo's (see text) had temporary and recurrent hæmaturia. The reason for this in uncomplicated cases is difficult to understand. It is by no means a common symptom, and, when present, is usually not so to a marked degree. Yet in Mayo's case it continued for seven weeks at a stretch and was sufficiently profuse to produce pallor. Painful micturition and strangury were mentioned in one instance. Drew's cases (Cases XXXV and XXXVI), which may, perhaps, be regarded as typifying cases with obstruction high in the ureter, complained of increasing pain and discomfort in the loin and frequency of micturition; both cases exhibited tumors in the loin. Here diagnosis of hydronephrosis must have been relatively easy, but the congenital cause could not have been foretold. Pain in the loin with a sausage-shaped tumor rising from the pelvis was present in our case at the Carney Hospital. Cystiform protrusions into the bladder, when they are large, are apt to give very marked symptoms, both subjective and objective. Boström's two cases (Cases XI and XIV) serve best to indicate what may probably be regarded as typical examples. His first case (Case XI) was that of a child six months old, who shortly after birth developed an increase in size of the abdomen which in a few weeks became very well marked. The child for days would pass no urine; when he did pass it, it was in large amounts and showed nothing characteristic. When two months old the boy had an evident three-lobed tumor, one lobe in the middle abdomen coming out of the pelvis and rising to the level of the umbilicus; each loin was occupied by a lobe of the tumor, which represented, as autopsy showed, a much distended bladder, and a double hydronephrosis caused by a cystic protrusion into the bladder sufficiently large to block the urethral and other ureteral opening. Boström's second case (Case XIV), a boy of twelve, had been healthy up to his eleventh year. Then night incontinence began; six months later frequent, painful, and difficult micturition was present. At that time the abdomen began to increase in size, and a fluctuant, movable, non-sensitive, kidney-shaped tumor was found rising out of the

pelvis to the level of the umbilicus, its upper end free and its lower end fixed in the pelvis apparently to the bladder. The right loin was more resistant than the left, but no tumor could be made out there. In the left lumbar region could be felt a sausage-shaped mass. The urine was negative. The autopsy showed an atrophied left kidney, a much dilated left ureter, a distended bladder, and a marked right hydronephrosis, all the result of a cystic protrusion into the bladder blocking the urethral opening. These, of course, are marked cases and for that very reason are quoted somewhat at length.

Schwarz [5] in commenting on these cases makes some pertinent observations with regard to diagnosis. In such a case as Case XI, for instance, catheterization of the bladder, while it might remove some urine, would nevertheless not cause the median tumor to disappear wholly, and the tumors in the loins would be entirely unaffected. He calls attention to the possible significance of the long-continued retention of urine, alternating perhaps with involuntary micturition, which last would occur in the horizontal position with elevation of the pelvis because of the falling back of the distended cul-de-sac from the urethral opening. How practical these suggestions are is questionable. Much would depend, it seems to us, on the degree of distention of the cul-de-sac and the closeness of its application to the bladder wall.

The Cooper-Rose case (Case LI) also is instructive from a diagnostic stand-point. The patient, a woman of twenty-eight, had for thirteen years been treated for a supposed ovarian tumor, which occupied much of the left side of the abdomen. For eleven years the patient's general condition was but little disturbed. Then pain and discomfort began. After her death at the age of thirty it was found that the tumor was a huge left pyonephrosis secondary to a wholly impermeable left ureter.

This congenital condition may coexist with other surgical kidney affections. In Lilienfeld's case (Case XV) and in one of Mayo's (Case LII) a stone was found in the renal pelvis.

In both these cases the stricture was at the vesical end of ureter. In another of Mayo's cases (Case LIII) an almost complete stricture was found 1½ in. below the kidney in the course of a nephrectomy for a tuberculous pyonephrosis. There was no explanation for the stricture other than on congenital grounds; the ureter below it appeared entirely healthy.

The urine is usually negative. Nichols's case and our case showed a moderate leucocytosis and a moderate rise of pulse-rate and temperature, but it is by no means clear that the ureteral condition had anything to do with this.

Infection will bring its usual train of symptoms. It is more to be feared in these cases because it may reach and affect the remaining sound kidney with disastrous results. The cystiform protrusions that have been of sufficient length to protrude from the external meatus, and have either sloughed or have been punctured, have invariably become infected, and always with fatal outcome.

Perhaps a knowledge of the existence of cases of congenital stricture of the ureter and of its results, and a more careful examination with that knowledge in mind, would have made a pre-operative diagnosis possible in Nichols's case and in our case at the Carney Hospital. However, in no case yet reported has such a diagnosis been made. The present widespread use of cystoscopy will render much easier the recognition and significance of the cystiform protrusion into the bladder. Young's case (Case VII) is illustrative of this fact. Ureteral catheterization and the X-ray (collargol plate) will find wider and wider use as aids in determining the location of strictures (Cases LII and LIII).

THE OPERATED CASES.

Cases have been operated on by Drew (Cases XXXV and XXXVI), Dudley Allen (XLVII), Wipple (XXIV), Mayo, Nichols, and the author. In no case was the diagnosis made previous to operation. Of Drew's cases one was cured and the other relieved, by pyelo-ureteroplasty, of the effects of con-

genital stricture near the renal pelvis. A perusal of his report makes one consider whether some of the cases instanced as examples of misplaced or abnormal origin of the ureter from the pelvis may not be more apparent than real, and whether the true situation may not be a pelvis so dilated through the effects of an ureteral obstruction (probably high) that its lowest level is forced below the point of origin of the ureter, thus causing that point to appear abnormally elevated. Again, his reports lead us to advise that in all cases of so-called idiopathic hydronephrosis not only should aberrant blood-vessels be sought for, but the calibre of the upper ureter should be carefully explored for stricture. To us these considerations appear practical.

The cases operated by Dudley Allen and by Wipple are also interesting, but for quite a different reason, in that they show how effective is a simple nephrostomy even in patients both of whose ureters must have been entirely obliterated at some point. In each case after a nephrostomy on one side all the urine escaped by the nephrostomy wound, none passing by the urethra. Wipple's patient, a woman of twenty-five, had had a right nephrostomy at the age of fourteen, and since that time had discharged all her urine through the operative opening; in her twenty-fifth year a left pyonephrosis made necessary extirpation of the left kidney. Recovery followed. Allen and Parker tell of a two and a half year old boy on whom a nephrostomy was done for a hydronephrosis filling the whole right side of the abdomen. Following this, practically all the urine was passed through the operative wound; yet the boy, aside from troublesome leakage about the tube, was perfectly well for over 12 years. Then nephritis showed itself and he soon succumbed. Autopsy disclosed a complete stenosis of the right ureter at the renal end and a congenital atresia of the left ureter near the bladder with a marked atrophy of the left kidney.

Drew in his cases circumvented the cause of the trouble. Wipple and Allen did away with its ill effects at least temporarily without removing the cause, but so far as I have

been able to ascertain Mayo's case, Nichols's case, and our case at the Carney Hospital are the only ones in which a successful removal of both cause and effect was possible and was accomplished. The history in brief of these three cases follows:

CASE REPORTS.

MAYO'S CASE (personal communication of Dr. E. S. Judd, first assistant surgeon, St. Mary's Hospital, Rochester, Minn.).—Female, married, aged forty-six. Seven years before consulting the Mayos she had passed bloody urine for a few days; at and after that time she had more or less pain in the upper left quadrant of her abdomen, varying somewhat in degree at different times, and shooting through to her back but never extending downward; each year she had one or two spells of bloody micturition; these were usually of only a few days' duration, but seven or eight months before entering St. Mary's she passed bloody urine for seven weeks, became pale, and for the first time thought she would have to give up and go to bed. Since that attack she had been feeling worse. Frequency of micturition had been a constant symptom, at first accompanied by pain, but of late painless. There was general abdominal tenderness and some resistance across upper abdomen, especially to left of epigastrium. Ureteral catheterization showed negative findings on the right; on the left, obstruction in the ureter near the bladder. Urine from the right side negative. At operation the left kidney and left ureter were removed. The kidney was hydronephrotic and the ureter was dilated to the size of the small intestine. It showed a stricture about one inch above the bladder. Recovery.

NICHOLS'S CASE.—Male, aged nine. Several days previous to entrance to hospital the child was seized suddenly with general abdominal pain and vomiting; the latter was not a prominent symptom. The pain had gradually grown worse and finally became localized over the appendix region; bowels were constipated. Before examination there was general spasm of the abdominal muscles, voluntary on the left side, both voluntary and involuntary on the right. Temperature 101° F., pulse 104; white count, 18,500. At operation the appendix was found to be normal. A large dilated kidney and a much dilated ureter were removed. There was a contraction of the ureter just below the kidney, and a more marked one (which would just take a fine probe) one-half inch above the bladder. Recovery.

AUTHOR'S CASE.—Male, aged six. One year before admission to hospital the boy had an attack entirely similar to that from which he was suffering at the time of his admission. He was in bed four or five days then. He was well from that time until two days before coming to the hospital, when he began to complain of abdominal pain, sore throat, and malaise. Vomiting fol-

lowed, and the abdominal pain became much worse and localized itself in the left lumbar region, shooting up the back; no bowel movement for forty-eight hours; never had shown any urinary symptoms of any kind; no muscular spasm of abdominal muscles. Temperature 101.6° F.; pulse 120; white count 16,400. A tender, sausage-shaped mass was palpable to the left of the spinal column above brim of pelvis. Though there was no history of blood-streaked mucus from the rectum, a probable diagnosis of intussusception was made. At operation a moderately large hydronephrotic kidney and a ureter dilated to the size of the small intestine were removed. There was a complete stricture 1½ in. above the bladder. The ureter was atrophied below the point of stricture. Recovery.

OBSERVATIONS ON DIAGNOSIS AND TREATMENT.

The diagnosis in any case is not a matter of ease. As has been said before, the present wide-spread and skilful use of the cystoscope, of the ureteral catheter, and of the X-ray will result in the relatively frequent recognition of the trouble, at least when it is present in adults; for to-day even unexplained frequency of micturition is sufficient ground for a cystoscopic examination. Lameness in the loin, pain, or an uncomfortable sensation there with some disturbance of urination should rouse our suspicions of a possible hydronephrosis. In children, the question is a more difficult one, and probably a large proportion of the cases will in them still remain undiagnosed. An increase in girth or a bulging in the loin may be the first sign in a child and should always lead to careful examination. Keeping in mind the possibility of the existence of such a pathological entity as congenital stricture of the ureter in its various forms will, I think, be a step in advance.

As to the treatment, the means must fit the case. It is evident that certain cases will require a nephrectomy and an ureterectomy. Nephrostomy may serve as an emergency measure. Paracentesis of the abdominal tumors is mentioned here only to be condemned, and yet Case LI demonstrates that even such a measure may afford at least temporary relief to a patient. Schwarz [5] speaks of the practicability of puncturing

from within the bladder the cystiform protrusions of blind-ending ureters, or of excising a portion of their walls. In women this would probably be a relatively easy matter through an operating cystoscope. In men, it would seem to be a matter of considerable technical difficulty. The combined intra- and extraperitoneal method of opening the bladder, advocated and practised by Harrington and C. H. Mayo, would, it seems to me, offer the best method of approach and of applying the necessary operative procedures to intravesical protrusions. In certain cases of cystic dilatation of the ureter just behind the bladder, ureterocystostomy might be practised.[14] Perhaps, even here, removal of the kidney and ureter would prove wiser and safer.

It is probable that the future will see many more pre-operative diagnoses of the condition.

ABSTRACT OF CASES.

A. Cases Showing Protrusion into Bladder.

CASE I.[15]—Female, aged five and a half months, had been ill for 2½ months with vomiting, diarrhœa, and loss of weight as symptoms. Physical examination was negative except for a purulent discharge from her right ear. Autopsy: abdominal organs negative. The right kidney (6 cm. by 3.5 cm.) and the right ureter normal. The left kidney (8 cm. by 4.5 cm.) shows a dilated pelvis filled with cloudy fluid; the kidney substance shows marked atrophy and small areas of infection. Arising close together from a common pelvis are two ureters united by fibrous tissue; both dilated and filled with cloudy fluid. The anterior one averages 3.5 cm. in diameter, and the posterior 2.5 cm. The walls are thin and delicate. Both ureters run together till bladder wall is reached; the anterior passes through the wall and opens normally into the bladder; its dilatation ceases when it enters the bladder wall. A little below and to the outer side of this the smaller, posterior ureter penetrates the bladder wall and opens into a blind cystiform protrusion into the lumen of the bladder. The protrusion is 2 cm. in circumference and "is produced by an uplifting of the tissue of the inner wall of the bladder." It is filled with cloudy fluid, and does not connect with the bladder cavity or with that of the other ureter. When filled, it obstructs the opening of the other ureter of the same side and thus produced the hydronephrosis. Adrenals normal.

CASE II (Burckhard[16]).—Male, aged sixty-two, died of pneumonia. Double hydronephrosis, more marked on right. Both ureters open into bladder by very small openings at the tip of protrusions. Both ureters

dilated just above bladder and just before reaching pelvis. Both ureters thickened.

CASE III (Davies-Colley[17]).—Female, aged eighteen months. Left ureter shows a finger-like protrusion 1 in. long into lumen of bladder. Left ureter dilated to size of finger. Left kidney pyonephrotic (infection probably due to an attack of measles).

CASE IV (Beach[18]).—Female, aged five months. Well up to six weeks before death. Then trouble with urination began. Death in four days. Left kidney and ureter normal. The right kidney showed at its lower end an apple-sized cyst from which ran a supernumerary ureter opening by a very small aperture into a blind cystiform protrusion into lumen of bladder.

CASE V (Ogle[19]).—Pelvis of left kidney widely dilated; the renal substance deficient. The left ureter dilated to size of pencil. Into the bladder projects a cyst the size of a small pea. This cyst communicates by bristle-like openings both with the lumen of the bladder and with the dilated ureter.

CASE VI (Johnson[20]).—Female, aged ten days. The right kidney enlarged and its pelvis distended; the right ureter dilated and curving. Left kidney, though imperfectly divided into two kidneys, has a continuous capsule. It has two ureters, both much dilated and tortuous; they join 1 cm. above point of entrance into bladder. Acute cystitis. The right vesico-ureteral orifice normal. "From the corresponding point on left side a protrusion covered with vesical mucous membrane extends downward, gradually increasing in size and ending in a bulbous enlargement, which with the parts in their natural position occupied the whole length of the dilated urethral canal and protruded externally between the labia. On its posterior surface the bulbous enlargement is attached to the floor of the urethra nearly as far as the orifice. On its right side the enlargement presents a long rent opening into the hollow interior, from which a probe can be passed upward into the ureter." The vagina, uterus, uterine appendages, and intestine were normal. Rupture of the bulbous enlargement occurred on the sixth day and child died of the subsequent infection.

CASE VII (Young[21]).—Male, aged forty-nine. Bloody micturition several times fourteen months before. No blood in urine since, though he has complained of frequency of micturition. Cystoscope showed a cyst, size of grape, at end of left ureter; pin-point left ureteral opening; the cyst swelled out every twenty seconds, carrying with it the ureteral orifice from which a fine stream came. As long as urine flowed, the cyst would remain dilated and would then collapse into a mass of wrinkled mucous membrane.

CASE VIII (Tangl[4]).—Female, aged sixty-seven. Right kidney and ureter normal; chronic interstitial nephritis of left kidney; congenital atrophy of left kidney; blind cyst-like projection of end of left ureter into bladder; gradual widening of lower section of left ureter; uterus biocularis unicollis. From the posterior surface of left kidney comes a projection with three entirely distinct arms (4 mm. broad and 3 cm. long) which

merge into a common cavity (the true pelvis, 14 mm. broad), the lower end of which is continuous with the ureter (6 mm. wide). The part of the ureter just above the bladder gradually widens and passes directly into a pouch beneath the mucous membrane of the bladder, projecting into the vesical cavity. The cyst in the bladder, when full, is spherical and of the size of a walnut. It contains yellowish-brown, muddy, thin fluid and is situated much lower and nearer the urethra than is the opening of the right ureter.

CASE IX (Boström[4]).—Description of a pathological specimen. A cystiform projection of right ureter into bladder; left ureteral opening normal; no right ureteral opening. In its place is a finger-like projection of mucous membrane, 6.5 cm. long, flaccid in its empty state, pear-shaped when completely distended; its greatest transverse diameter is 5 cm., and this is gradually reduced in the direction of the tip which is 5 mm. broad. It has no communication with the bladder. Its inner lining of mucous membrane is directly continuous with that of the right ureter, and the ureter opens widely into the cyst-like protrusion. The ureteral wall is somewhat thickened and the opening into the cyst is abnormally widened (12 mm.). The specimen does not show the upper part of the ureter and the kidney. It must be assumed that the much dilated ureter and the kidney were destroyed by the highest grade of hydronephrotic atrophy. The bladder was large and showed muscular hypertrophy.

CASE X (Otto[4]).—Six months' fœtus. Large abdominal hernia; malformation of cloaca and pelvis; liver without gall-bladder; small intestine ends in the cloaca; both kidneys without suprarenals; absence of right ureter; left ureter dilated, tortuous, and ends in a blind sac in that portion of the cloaca which would correspond to the urinary bladder.

CASE XI (Boström[4]).—Male, aged twelve. Apparently healthy up to the age of eleven and a half; then began to complain of urinary symptoms and to increase in girth; urination increased in frequency and in difficulty; strangury; the boy was well nourished. Abdomen, particularly between symphysis and navel, was considerably distended, and there was a non-sensitive tumor, dull to percussion, lying close beneath the abdominal wall between the symphysis and navel; the tumor was kidney-shaped and could be moved easily to the right or left. At the pelvic end it was fixed; the upper end was free; surface smooth; tensely elastic; on fixation undoubtedly fluctuant. There was more resistance in the right than in the left loin, though a distinct tumor could not be felt there. In the left lumbar region a long, sausage-shaped tumor with its long axis lying transversely could be rolled under the finger. It was fluctuant and was lying partially on the spinal column and behind the intestine. Urine showed a specific gravity of 1007, was acid, clear, with a trace of albumin and no sediment. Puncture of the tumor between the navel and the symphysis gave a watery, clear, light-yellow acid fluid without albumin or sugar; did not coagulate on standing; it contained no succinic acid and about as much chlorides as urine. The diagnosis lay between hydronephrosis and an echinococcus cyst. Double puncture of the two abdominal tumors was made with the hope of securing adhesion formation and a later oppor-

tunity of opening the tumors. Death from meteorism (?) (peritonitis). Autopsy showed congenital closure of the left ureter with cyst-like projection of the vesical mucous membrane. Enormous dilatation of the left ureter. Marked atrophy and abnormal position of the left kidney; renal blood-vessels abnormal. Marked hydronephrosis of the right kidney. Enormous dilatation of the bladder. The projecting vesical mucous membrane through its tense filling with urine completely closed the urethral opening so that urination was quite impossible.

CASE XII (Rott[4]).—Male, aged fifty-two, dead of phthisis. Right kidney absent with its pelvis and vessels. Near the side of the fourth lumbar vertebra began the right ureter which increased distinctly in volume as it went downward; in places it appeared lobulated. In the right vesicorectal space it was crossed by the vas deferens, with which it communicated by a very fine opening. Below this point the ureter reached a diameter of over 2 cm., but was narrowed at certain places by shallow constrictions. It reached the base of the bladder at the normal place, but had no opening into it. In place of the normal opening was a half spherical cystiform protrusion into the bladder lumen; its base reached to the caput gallinaginis; the protrusion had a diameter of 2 cm. and the ureter opened into it by a gradually decreasing lumen. The portion of the ureter below the vas deferens and the protrusion formed an elastic fluctuating cyst with walls under high tension.

CASE XIII (Lechler[4]).—Female, aged three months. Shrieked with every urination. Labia majora pressed apart by a cyst (size of dove's egg); it was very tense and appeared to come through the vaginal opening. It looked like the bladder. It was replaced, but on the third day appeared again; urine suddenly shot out from it. Death in 28 hours. Right kidney and right ureter normal; left kidney was twice normal size and the upper half was cystically dilated. One ureter left the kidney in the usual way; from the cystic dilatation came a second ureter, which was widely dilated, shaped like a hen's intestine, and ran tortuously through cellular tissue down into the pelvis. Base and body of the bladder normal; vesical neck somewhat lengthened; urethra wanting; the neck of the bladder opened directly into the outer air. The bladder was then opened through its anterior wall and there appeared a "second bladder" which was the dilated blind end of the ureter from the cystic upper portion of the left kidney.

CASE XIV (Boström[4]).—Pathological specimen from the body of a 23-weeks-old girl. Shortly after birth there appeared a rather well-marked abdominal swelling which increased in size and which four months before death presented as a three-lobed tumor, one lobe in the centre joined with one in either kidney region. The median one rose out of the pelvis to the level of the navel; it seemed to be connected with the bladder. The child for days would pass no urine. When urine did come, it was in large amounts but showed nothing striking. Autopsy showed reduplication of both ureters; embryonic closure of one ureter with cystiform projection of vesical mucous membrane, which blocked the internal urethral opening and compressed the other ureteral openings; double hydronephrosis; marked dilatation and muscular hypertrophy of the bladder.

CASE XV (Lilienfeld[4]).—Pathological specimen from body of a male, aged sixty-five, dead of typhoid. At upper end of right kidney is a structure which is assumed to be a degeneration of the parenchyma. From the pelvis (contracted about a stone) of this portion of the kidney ran a ureter which proceeded with the normal ureter (joined to it by connective tissue), penetrated the bladder somewhat below it, and ended in a cystiform protrusion (filled with clear liquid) into the bladder lumen.

CASE XVI (Heller[4]).—Female, aged seventy-nine, dead of pneumonia. Autopsy showed an enormous, fluctuant cyst, arising from the right side and filling the whole abdominal cavity; scanty remnants of renal substance in the wall of the cyst; in bottom of sac was an opening which led into a dilated (2–3 cm. wide) ureter with a thick, flabby wall; the ureter ran with many twistings and turnings down to the bladder and ended blindly in a cystiform protrusion into the vesical lumen. On the anterior surface of the cyst was a flattened kidney, from the pelvis of which a ureter led down and opened into the bladder above the other ureter of the same side. On the left, the otherwise normal kidney was separated into an upper and lower half, each with a fairly normal pelvis; from each pelvis ran a ureter; these joined just before reaching the bladder and opened into it by a common trunk.

CASE XVII (Geerdts[4]).—Female, three weeks old. Child had complained for eight days of a diarrhœa and abdominal distention. Suddenly a tumor appeared at the vaginal opening. It came through the urethra and could be pressed back through it. A plastic operation was done on the urethra, but the tumor soon appeared again and finally sloughed. The child died of what seemed to be general peritonitis. Autopsy showed a general peritonitis; right kidney and ureter normal; on the left side a double renal pelvis; both dilated, especially the upper, which was filled with pus; from the lower ran a normal ureter which opened normally into the bladder; from the upper pelvis a dilated ureter ran down and ended in the bladder in a cystiform protrusion, which had finally passed through the urethra and formed the tumor mentioned above.

B. Cases Showing no Protrusion into Bladder.

CASE XVIII (Welz[8]).—Child, aged two and a half months. Ill four weeks. For the first two weeks had convulsions; then followed a week of quiet; almost continual convulsions since. No vomiting; stools yellow and thin; abdomen somewhat distended but soft. Autopsy showed a lobulated left kidney; capsule easily removed; right kidney somewhat larger; both ureters dilated, the right more than the left; rather small, somewhat thickened bladder with pale mucous membrane; opening of right ureter into bladder obliterated; hydronephrosis of both kidneys; internal hydrocephalus.

CASE XIX (Meschede[4]).—Left kidney absent. Right enlarged more than half. In the bladder the ureteral orifice was present only on right side. Where the left one should have been was only a dimple in the mucous membrane. On the outer bladder wall, corresponding to the loca-

tion of the dimple within, was an embossed cyst the size of an egg, from the upper part of which ran a hollow cord which communicated with the cyst at its lower end, but which ended blindly above in the subperitoneal tissue at a point a finger's breadth below where left kidney should have been. Yellowish fluid in the cyst.

Case XX (Vignier[4]).—Atresia ani; small kidneys and dilated ureters. Left kidney larger than right; the left ureter goes to the bladder without opening into it; the right ureter does not connect with the bladder; its lower end narrows suddenly and connects with the rectal ampulla by an opening as fine as a hair.

Case XXI (Otto[4]).—Monster. Abdominal hernia, which includes the liver, gall-bladder, stomach, pancreas, spleen, and small intestine. Behind the hernia were two kidneys; left kidney smaller; left ureter absent; right ureter ends in cloacal wall.

Case XXII (Otto[4]).—Monster. Abdominal hernia; spina bifida; cloaca; two suprarenals; wide, tortuous ureters which end in blind cysts not connecting with the bladder. Uterus, tubes, and ovaries reduplicated.

Case XXIII (Montmollin[4]).—Full-term child. Arrest of development of intestine and urinary organs; atresia ani; large intestine ends in blind sac at level of promontory; similar ending of left ureter; right ureter connected with bladder by a fibrous cord.

Case XXIV (Wipple[3]).—Female, aged twenty-five. At fourteen years of age symptoms of right-sided hydronephrosis appeared, which indicated nephrotomy. All the urine flowed through the operative fistula; no urine came from bladder. In her twenty-fifth year, severe pain and tumor formation in region of left kidney; incision, evacuation of pus, and later extirpation of the left hydronephrotic sac; left kidney atrophied. Recovery. There must have been congenital strictures of both ureters.

Case XXV.[5]—Alcohol preparation of eight months' fœtus, dead of suffocation. Beginning double hydronephrosis due to congenital atresia of ureters at vesical openings. Slight dilatation of both ureters.

Case XXVI (Weigert[3]).—Specimen showing the abdominal and pelvic organs of a new-born, full-term child. Perineum included in the specimen; no anal opening; rectum and large intestine much dilated; small intestine, liver, biliary passages, and stomach normal; left ureter opens into bladder normally; it is 14 cm. long, is dilated, and opens above into a dilated pelvis; calyces distended, papillæ flattened; otherwise, kidney and suprarenal normal. On the right side, no vesical opening of the ureter. The rectum opens into urethra near caput gallinaginis. In place of right kidney is a conglomeration of cysts to which go vessels from the aorta forming a sort of hilus; from the conglomeration of cysts goes out a ureter which for a distance of 2.4 cm. has a visible lumen, and is then continued as a solid cord to the posterior surface of the bladder, where it is lost. No right seminal vesicle.

Case XXVII (Mutach[3]).—Male; died thirty hours after birth. Tumor (size of fist) in right kidney region; it extended toward median line and down into pelvis. Right kidney showed marked cystic degeneration; cysts were thin walled and contained clear fluid. Opening of right ureter

into bladder had a circumference of 2 cm., but the ureter narrowed as it extended upward and was obliterated 5.5 cm. from kidney. It soon again showed a lumen and retained it till it reached the hilus and communicated by a minute opening with a calyx. The left kidney was simply a conglomeration of cysts containing clear fluid. The left ureter had a normal vesical opening, but was completely obliterated 2 cm. above it, where it formed a fibrous cord, which, near the kidney, again took on a lumen which could be traced with a sound only to the hilus. Closer examination proved that it connected with a calyx as did the right ureter.

Case XXVIII (Haviland[5]).—Male, aged eighteen. Well up to 12 years of age when he fell 20–30 feet. He seemed to be only shaken up and a quick recovery followed. Since then, however, he had had painful urinary incontinence; blood and pus in urine; autopsy showed left kidney degenerated into a number of sacs with contents resembling pus. Each sac was separated from its neighbor by a distinct membrane. An outlet from these sacs was not to be found. The left ureter was atrophied, impermeable, and surrounded by a thick layer of fat. The right kidney was pale and hypertrophied, and had at each end a cavity containing pus. The right ureter was much dilated and surrounded by fat and many indurated lymph-vessels.

Case XXIX (Osterloh[4]).—Girl, new-born. Double ureter on left side. The left lower ureter normal; the left upper ureter dilated and ended blind in a cyst behind the bladder. Upper half of left kidney was hydronephrotic.

Case XXX (Stoltz[4]).—Right side of uterus well developed; the left horn had tube and ovary but was atrophied. The right kidney had two ureters; the upper ran from a sort of thick-walled cyst downward to end blindly in the bladder wall on the left side. The lower ureter was entirely normal. There was no trace of left kidney.

Case XXXI (Teyssèdre[6]).—Male, aged one and a half years, dead of measles. Congenital absence of right kidney; right suprarenal present; atrophy of right renal vessels; both ureterovesical orifices normal; right ureter permeable from bladder to level of iliac fossa; from there to the place where right kidney should be it is only a fibrous cord. The other genito-urinary organs are normal.

Case XXXII (Ferrand[22]).—Male, aged four and a half years, dead of diphtheria. Left kidney absent; left pelvis represented by a closed cyst, from the outer wall of which a dilated ureter ran down to a cystiform dilatation outside the posterior bladder wall.

Case XXXIII (Fenwick[23]).—Specimen from a male, aged sixty, dead of cerebral hemorrhage. Right kidney enlarged but healthy; left kidney represented by a stiff-walled, multilocular sac of the size of a goose-egg and containing a thin, white, opaque fluid glistening with cholesterin crystals. Wall of cyst is calcified. Left ureter is an impervious cord; no left ureterovesical opening in bladder.

Case XXXIV (Pelissier[24]).—Male, aged twelve. For years abdominal pain radiating into the loins; occasional inability to urinate, and finally loss of control of urination. The abdominal pain grew worse, fever

began, and boy's condition became hazardous. Abdomen distended and tender. Below was a central dull area reaching to the umbilicus; flanks clear; fluctuating tumor parallel to right groin. The X-ray showed a vesical stone which was removed suprapubically; drainage; no improvement; death. Autopsy showed abdominal organs normal; right ureter distended to size of thumb; right kidney enlarged; left ureter size of small intestine; both kidneys were simply pockets of pyo-uronephrosis; parenchyma practically destroyed. Ureters could be catheterized only in a retrograde way and then only with filiforms, because of punctiform openings (like openings of lachrymal ducts) into bladder. This was evidently a congenital deformity which probably began in infancy and was progressive; infection came through formation of stone in bladder.

Case XXXV (Drew[25]).—Female, aged thirty-four. Tumor in left loin for four years; it gradually increased in size, and pain as well as frequency of urination were accompanying symptoms. Operation: one pint of urinous fluid from renal pelvis; renal substance considerably damaged, but the organ was obviously still good; stricture (¼ in. long) of ureter just as it entered pelvis. The stricture was not cicatricial but evidently congenital; it would just admit a probe. The ureter entered the hydronephrotic pelvis ¾ in. above its level: pyelo-ureteroplasty resulted in cure.

Case XXXVI (Drew[25]).—Female, aged fifty. Tumor in left abdomen for 1¼ years. With its gradual increase in size pain began, and there was increased frequency of micturition. Operation: 1¼ pints of urinous fluid from the pelvis. The kidney substance was not damaged. The upper four inches of ureter was much narrower than normal; orifice would just take a probe. Ureteral orifice enlarged by a pyelo-ureteroplasty. Marked improvement four months after operation.

Case XXXVII (Corsy[26]).—Autopsy subject, dead of tuberculosis. Right kidney was normal, except that pelvis is slightly distended with a clear liquid that cannot be forced out; four cm. below the pelvis the ureter shows a stricture which diminishes the ureteral calibre by one-half. On the left side there is no hydronephrosis, but at the same level as on the other side there is an ureteral stricture which is not so well marked. Pathological stricture is out of the question; there is no elbowing, and no aberrant vessel.

Case XXXVIII (Shield[27]).—Male, aged seven months, complained of diarrhœa and vomiting for three weeks. On the right side completely filling the loin was a large mass, firmly fixed, apparently solid and palpable by rectum. Death. Autopsy showed the mass to be an enlarged right kidney of the size of a cocoanut. Right ureter ended in a fibrous cord; no opening into bladder; upper part of ureter much enlarged (2 inches in circumference); it coiled downward into the pelvis, which is almost completely filled by it; it pressed on the rectum and left ureter, which with the left kidney is enlarged and hyperæmic. The disorganized right kidney and the right ureter were filled with yellow pus, the source of which was unknown.

CASE XXXIX (Auscher[28]).—Male, aged one and a half years, dead of measles. Left kidney slightly enlarged; right kidney of the size of a bean, had arteries going to it. In the bladder there was nothing abnormal. In the pelvis and iliac fossa the right ureter was normal but slightly smaller than the left; just as it clears the fossa it diminishes rapidly in size and runs as a thin impermeable cord to the rudimentary right kidney. Testicles, vas deferens, etc., normal.

CASE XL (Handford[29]).—Male, aged nineteen. Great foot-ball player. He was seized suddenly with acute chorea and was sent to an asylum; death in fourth week of illness. Autopsy showed a much enlarged left kidney; the right kidney was represented by a cyst (size of a filbert). The right ureter, dilated to the size of the small intestine, contained clear fluid. Both ureteral openings were present in bladder, but a probe passed into the right ureter met an impassable obstruction ½ inch above opening; right adrenal normal; right renal vessels atrophied but normal in origin and course.

CASE XLI (Pitt[30]).—Male, aged twenty-two, killed by train. Left kidney distended and its pelvis considerably enlarged; the left ureter at its junction with the pelvis was very small and would just take a probe the size of a No. 2 catheter. The kidney structure was practically normal.

CASE XLII (Ord[31]).—Male, aged one year, dead of anæmia; hydronephrosis (side not mentioned) due to stricture at point of exit of ureter from renal pelvis; kidney dilated and contained urine turbid with pus-cells.

CASE XLIII (Pollock[32]).—Male, aged sixty-two. Twenty years before he had had dropsy and general anasarca. Except for dizziness he had been well since then till very recently, when attacks of suppression of urine began; death from uræmia; autopsy showed an atrophic, cystic left kidney; the left ureter is impervious throughout its whole course and has no opening in the bladder; right kidney large and healthy. The right ureter was plugged at its lower end by a calculus.

CASE XLIV (Sainsbury[33]).—Female, aged thirty-four, dead of uræmia. Right kidney shows advanced nephritis. Right ureter patent; left kidney represented by a pyonephrotic sac filled with a soft, thick paste; left ureter patent in upper two-thirds, but calibre was lessened. Two small, valve-like flaps at the same level effectually closed the outlet of the pelvis into the ureter; lower third of the ureter impermeable; no opening into bladder; the valves and the impermeability congenital. In this case the impermeability of the lower third of the ureter was a potential rather than an actual cause of obstruction.

CASE XLV (Pitt[34]).—Young adult. The left kidney was hypertrophied; the right kidney only half normal size; thick, dense stricture of right ureter about ½ inch from renal pelvis.

CASE XLVI (Penrose[35]).—Male, aged twenty-five. There was an absence of upper two-thirds of left ureter, and the left kidney was very small and cystic.

CASE XLVII (Allen and Parker[36]).—Male, aged two and a half years, seen in May, 1889, with a markedly enlarged abdomen due to a

collection of fluid filling the whole right side. Operation. A greatly distended kidney held the collection of fluid. An attempt to shell it out had to be given up because the child was in poor condition. Drainage. Patient recovered from the operation. For a few weeks he passed a few drachms of urine *per urethram*. After this time all passage of urine by the natural channel ceased, and up to the time of his death (February, 1902) he passed no urine whatever except through the operative opening in his side. Apart from the annoyance of wearing a silver tube in the opening which discharged constantly into a rubber bag, and apart from the fact that no satisfactory way could be devised for collecting the urine at night, the boy was perfectly well, went to school, etc., and appeared to be in normal health till June, 1900. Then the tube began to trouble him greatly and he was much annoyed by leakage of urine around it. Under ether, the opening was enlarged. He was not seen again till January, 1902. Then he looked pale, had had a severe hemorrhage from his nose and a considerable discharge of blood from his side. He showed slight œdema of his face and legs and an enlarged heart. The hemorrhage from the kidney continued and the boy died of uræmia in February, 1902. Autopsy showed complete stenosis of right ureter at renal end; slight dilatation of right ureter, associated with valve-like folds in the mucosa. Hemorrhagic pyelonephritis with marked distention of the right kidney; fistula between lower end of right renal pelvis and abdominal wall; hypertrophy of right kidney with acute and chronic nephritis and pressure atrophy; the left ureter lobulated and looking like a string of sausages, bow-shaped, dilated (3–4 cm. in diameter), and nearly filled with 200 c.c. of clear, amber-colored fluid which flows freely from one part to another; the ureter extends to the bladder but does not communicate with it. On section the walls are thin, and valve-like folds are seen narrowing its lumen in places. Mucosa normal in appearance; left renal pelvis slightly enlarged and envelopes about two-thirds of circumference of kidney. It communicates only with a single calyx. Left kidney shows chronic interstitial nephritis with marked atrophy.

Case XLVIII (Förster[4]).—Still-born male fœtus (seven to eight months). Left kidney and ureter absent; left suprarenal (larger than the right) lay in its usual place; right kidney, somewhat larger than normal, was in the usual position; its calyces and pelvis somewhat dilated; no suggestion of double kidney; the right ureter is much dilated and runs tortuously beneath the lower end of the colon to open in the left side of the bladder at the exact place where, under normal condition, the left ureter would open; the orifice is very narrow and takes the smallest probe. Where the right ureter should open normally there was no trace of an opening.

Case XLIX (Billard[37]).—Child, aged one month. Huge hydronephrosis; the left ureter terminates normally in bladder, but above forms two thin impermeable strings joined to the renal pelvis by a series of cords.

Case L (Thurmann[38]).—Large congenital hydronephrosis due to an entirely impermeable ureter.

CASE LI (Cooper-Rose[8]).—Female, aged twenty-eight years. Under treatment for thirteen years for supposed ovarian tumor. When she was fifteen, an indistinctly fluctuant tumor (size of fist) was felt in region of left ovary. For two years before that time there was occasional hæmaturia; after the discovery of the tumor, frequent attacks of hæmaturia. The tumor grew rapidly and in three years occupied the whole left side of the lower abdomen; much pus and blood in urine; for eleven years her general condition was but little disturbed; then distention of the abdomen and pain began, and a fluctuating area made its appearance between the navel and the crest of the left ilium. A needle was introduced and seven pints of hæmo-purulent fluid containing no urinary salts was withdrawn. Following this the tumor grew much smaller (size of fist), but the fistula remained open and discharged pus. Death two years later. Autopsy showed a large cystic tumor (6 in. by 3 in.), occupying place of left kidney; no kidney substance; cyst contained blood and pus. The left ureter was a solid cord. The right kidney showed parenchymatous nephritis.

CASE LII (Mayo[39]).—Female, aged forty. For seventeen years patient had frequent attacks of rather typical renal colic on left side; the usual pain was complained of; blood and pus in urine; fever and chills at times. Attacks have increased in frequency of late; left kidney area tender; tenderness in left iliac fossa; right kidney palpable; cystoscopic examination showed "roughening in left ureter; urine coming from that side." X-ray (collargol plate) disclosed "obstruction of left ureter near bladder; hydro-ureter." Operation. Hydronephrosis with stone in pelvis of kidney; stricture of ureter ("probably congenital") ¾ in. above the bladder; kidney and ureter removed; ureter dilated to size of small intestine. Recovery.

CASE LIII (Mayo[40]).—Male, aged twenty-four. For five years patient had frequent urination day and night; smarting and pain in penis before and after urination; pus in urine for some months; some years before some blood in urine; three attempts (the last under ether) failed to catheterize the entire left ureter. Operation: nephrectomy for tuberculous pyonephritis; stricture of left ureter 1½ in. below kidney; it was almost complete; the ureter below it looked healthy. Recovery.

Cases LIV, LV and LVI will be found in text.

BIBLIOGRAPHY.

[1] Keith: Human Embryology and Morphology, London, 1902.
[2] Huntington: The Harvey Lectures, New York, 1906-1907, 222.
[3] Cited by Welz: Inaugural Dissertation, München, 1903.
[4] Cited by Schwarz: Beitr. z. klin. Chir., 1896, xv, 159.
[5] Schwarz: Beitr. z. klin. Chir., 1896, xv, 159.
[6] Welz: Inaugural Dissertation, München, 1903.
[7] Veau: Gaz. d. hop., 27 Mar., 1897.
[8] Teyssèdre: Thèse de Paris, 1892.
[9] Delore and Carrel, Alexis: Gaz. hebd. de med., 6 Apr., 1899.

[10] Brinon: Thèse de Paris, 1896.
[11] Hamann: Jour. Med. Research, Boston, 1902, iii, 125.
[12] Lindemann: Zeitschr. f. klin. Med., 1898, xxxiv, 299.
[13] Sollman, Williams, and Briggs: Jour. Exper. Med., 1907, ix, 71.
[14] Wölfler: Cited by Veau, *l. c.*
[15] Rec. Mass. Infant Asylum, Boston, Jan., 1910.
[16] Burckhard: Centrlb. f. all. Path. und path. Anat., vii, No. 4.
[17] Davies-Colley: Lancet, London, 15 Mar., 1879, 372.
[18] Beach: Tr. London Path. Soc., xxv, 185.
[19] Ogle: Tr. London Path. Soc., xlv, 127.
[20] Johnson: Tr. London Path. Soc., 1901.
[21] Young, Hugh: Ann. Surg., xxxvii, 690.
[22] Ferrand: Bull. Soc. anat. de Paris, xxxvii, 48.
[23] Fenwick: Tr. London Path. Soc., xxxvii, 300.
[24] Pelissier: Arch. provinc. de chir., June, 1909.
[25] Drew: Tr. Clin. Soc., London, xxxviii, 1905.
[26] Corsy: Marseille. Méd., 1908, xiv, 215.
[27] Shield: Lancet, London, 1900, i, 1131.
[28] Auscher: Bull. Soc. anat. de Paris, 1892, 321.
[29] Handford: Tr. London Path. Soc., xxxvii, 285.
[30] Pitt: Tr. London Path. Soc., xxxviii, 168.
[31] Ord: Tr. London Path. Soc., xlvi, 132.
[32] Pollock: Tr. London Path. Soc., xvi, 181.
[33] Sainsbury: Tr. London Path. Soc., xxxvii, 296.
[34] Pitt: Tr. London Path. Soc., xlvii, 113.
[35] Penrose: Tr. London Path. Soc., xl, 161.
[36] Allen and Parker: Jour. Exper. Med., 1907, ix, 82.
[37] Billard: Cited by Arnould (Thèse de Paris, 1892).
[38] Thurmann: *Idem.*
[39] Mayo: Communicated by Dr. E. S. Judd, case No. A, 30271.
[40] Mayo: Communicated by Dr. E. S. Judd, case No. A, 2716.
[41] Robinson: Anat. Anz., xxiv, 482–485.

PRIMARY (CONGENITAL) HYDRONEPHROSIS.

REPORT OF A CASE WITH REMARKS ON THE TREATMENT AND PATHOLOGY.

BY CHARLES GREENE CUMSTON, M.D.,

OF BOSTON, MASS.

CONGENITAL, or speaking more correctly, primary hydronephrosis is not what may be termed infrequent, while the acquired form is very rare in children. The latter may be the result of ureteral compression by a malignant tumor, by adhesions resulting from a tuberculous peritonitis, or an hydatid cyst of the under surface of the liver. Uric acid sand has been said to be the most frequent factor, as it accumulates at either the upper or lower ureteral orifice, causing obstruction of the lumen. The affection is apt to be bilateral, and the hydronephrosis usually is only incomplete and partial. The renal enlargement is not excessive. Dilatations occur in the ureter, but the renal pelvis may not of necessity become dilated. It may occasionally result from a ren mobilis, just as occurs in the adult.

The primary or congenital type is nearly always due to malformation of the ureter, such as absence or stricture of the tube, but sometimes the pathogenesis remains very obscure, exploration of the ureter showing it to be apparently perfectly normal.

The case that I have to report occurred in a girl, two years and eight months of age, who was referred to me in November, 1903. There was little of interest in the past history excepting that she had always been a rather weakly child. About seven months before seeing the patient, her mother had noticed some distention of the abdomen, and this had gradually increased. At the same time the child complained of pain each time the bowels moved, and there was some diarrhœa. The patient was referred to me with a diagnosis of probable tuberculous peritonitis.

Examination showed that the bony structures and muscular tissue were fairly well developed, but that of late the child had been losing flesh. The abdomen was greatly distended and by inspection it was evident that the left half was decidedly more so than the right. By palpation a tumor could be distinctly made out protruding from under the left costal border and extending towards the middle line nearly to the umbilicus. The fingers could be made to enter between the lower pole of the growth and the iliac bone. The surface was smooth and uniform, the tumor was immovable but showed slight synchronous movements with the respiration. By pressure with the hand some gurgling could be elicited over the surface, showing that some intestinal coils were present between the growth and the anterior abdominal wall. The tumor felt quite hard, fluctuation could not be made distinctly evident, but a liquid thrill was obtained by tapping the side of the abdomen with the finger. The right half of the abdomen was somewhat tympanitic, while percussion showed that there was a uniform dulness over the entire extent of the growth.

The urine was voided in sufficient quantity, was a light yellow in color, acid in reaction, and microscopically presented nothing abnormal.

The diagnosis lay between a malignant renal growth and hydronephrosis. The child was placed under observation for several weeks, but no change occurred, and given the thrill obtained by tapping the growth with the finger, it was evident that fluid was present, so that a diagnosis of primary hydronephrosis was made.

I would also say that the temperature was at no time raised and that the urine, which was carefully followed, never diminished in amount and never presented any pathologic products during the several weeks that the child was under observation.

Operation was advised and accepted and was performed on December 27, 1903. An incision, beginning at the external border of the spinal muscle mass, was carried from the tenth rib downwards and transversely to the iliac crest; the exposed kidney then protruded into the wound and distinct fluctuation was evident. An incision into the cyst gave exit to 1300 c.c. of fluid (some more of which was lost). It was a straw-colored, slightly cloudy liquid which, upon examination, showed a large amount of albumin and some urea.

After the liquid had been evacuated, the sac collapsed and could then be drawn out through the wound to a certain extent, but it was very adherent in the region of the upper pole and towards the vertebral column. When it had been completely freed after a rather difficult dissection, it was found that the pedicle was very atrophied, the renal vessels having almost disappeared, while a stricture was found in the ureter about 5 c.c. below its junction with the renal pelvis, which completely occluded its lumen. The wound was sutured excepting at its upper angle, where a cigarette drain was inserted.

On the following day the temperature was normal, the pulse 101, and the general condition good. The quantity of urine passed in 24 hours amounted to 800 c.c., and analysis showed that it was exactly as before the operation.

The child made an uninterrupted recovery in spite of an intercurrent attack of bronchitis, and was discharged three weeks after the operation. I saw the patient in May, 1908, consequently four years and a half after the operation, at which time she was a well-developed girl and had enjoyed good health ever since the interference.

Examination of the cyst showed that its walls varied from 4 to 7 mm. in thickness, while at the anterior aspect of the lower pole its thickness reached its maximum. Microscopic examination of this part of the sac showed, in the first place, a large amount of connective-tissue growth. At various points a large number of uriniferous canals were found, whose epithelium only took the stain slightly and most of it had desquamated. The nuclei did not stain at all and the uriniferous canals were choked by the shedding of the epithelium. No normal glomeruli could be detected, but their remnants were present. Evidences of a capillary circulation were present, but, apparently, the vessels had lost their functions. From this examination it is evident that we have the picture of a severe interstitial nephritis.

In the *Pathological Transactions,* vol. xi, is to be found a very interesting paper by Griffiths, entitled, " The Histological Changes in the Kidney in Hydronephrosis." He does not consider the changes, such as occurred in our case, as a direct result of pressure exerted on the renal calyces, which in turn causes an interstitial overgrowth of connective tissue with a

complete disappearance of the uriniferous canals, but he explains the process which leads to such changes in the renal parenchyma in a somewhat different manner. According to his way of thinking, these occur only when the renal pelvis is greatly distended, resulting in a distention and flattening of the renal vessels, which also become contracted by a form of arteritis and endarteritis.

Referring to the stricture of the ureter found in the case reported, I believe that it is more than probable that it had developed before birth and should be considered as a congenital defect. It must have been partially patent for a time at least, and little by little contracted down so as to completely occlude the lumen of the canal and thus gave rise to the complete hydronephrosis. Then, again, the hydronephrosis must have been present for some time on account of the very marked and advanced renal atrophy. It is also quite possible that a dilatation of the renal pelvis had been present since birth, and little by little became more and more distended as the ureteral stricture narrowed down.

The location of the tumor in the left half of the abdomen, extending down to the bony pelvis, might have been either a splenic or renal growth, but that it was retroperitoneal was made evident by the presence of a few intestinal coils between the tumor and the anterior abdominal wall. Since a thrill without any evident fluctuation could be elicited, it was evident that the contents were fluid, and, therefore, a malignant growth could be practically eliminated.

In female children a large primary hydronephrosis might be mistaken for an ovarian cystoma, but a differential diagnosis may be readily arrived at from the fact that when arising in the ovary the cyst, as it develops, pushes the intestine to one side and the coils are never found between the growth and the anterior abdominal wall. Then, again, rectal or vaginal examination will make the diagnosis of ovarian cyst certain. The contents of a hydronephrotic cyst are distinguished from those coming from an ovarian cystoma by the larger amount of urea they contain. It is quite true that urea may be

absent in the fluid from a hydronephrosis, when atrophy of the renal parenchyma has reached such an extent that no normal uriniferous canals are present.

Of other renal growths an echinococcus cyst is the most likely to cause confusion, but in these cases an exploratory puncture will reveal the true nature of the affection.

Malignant disease of the kidney is not infrequent in children, and the growth may be of such soft consistency as to give rise to pseudofluctuation.

Very frequently a differential diagnosis between a hydronephrosis and a congenital cystic kidney can hardly be made, but in the former one may usually elicit a pronounced fluctuation. Then, again, in the polycystic kidney the growth is almost always noticed from the time of birth. However, an absolute diagnosis may not be reached in many cases, but from a practical standpoint, this is of no great value, because in both, surgical interference is indicated. In typical cases when the hydronephrosis is not due to the closing down of a ureteral stricture, we get many characteristic symptoms, such as the occurrence of renal colic, intermittent polyuria which results in a decrease in the size of the swelling, all of which are sufficiently characteristic to render the diagnosis an easy matter.

Regarding the treatment of primary hydronephrosis opinions vary, but it would seem to me that all liquid tumors require an early operation, provided that the other renal gland is carrying out its normal functions. The polycystic kidney, being usually bilateral, should be left alone. However, the process may involve but one kidney and produce compression symptoms, but it is just in these cases that the true nature of the lesion is not diagnosticated, because the affection is here unilateral. If the other kidney is healthy, nephrectomy may be done, but one should always recall that at a later date the remaining kidney may, and undoubtedly will, undergo the cystic change.

No single operative interference can be applied to primary hydronephrosis in children. If it should be the result of a

nephroptosis, fixation of the kidney may alone be required, and, if the functions of secretion are sufficient, some one of the plastic operations on the ureter and renal pelvis will find its indication. If the surgeon is convinced that the diseased kidney possesses no functional value, I believe that nephrectomy should be done when possible, preferably by the extraperitoneal lumbar route. Nevertheless, many operators are not of this opinion and prefer nephrotomy. Küster has reported 11 cases in which he successfully performed nephrotomy for hydronephrosis and only one resulted in a fistula. Mendelsohn and Wagner are of the opinion that it is a mistake to deal with a hydronephrosis other than by nephrotomy. They believe that, in those cases where a good result can be obtained by a simpler interference, nephrectomy is a too severe operation, and is also contraindicated because it should be the endeavor of the surgeon to save every bit of functionally active kidney parenchyma that is possible, not only for the ultimate welfare of the patient, but also to avoid the appearance of uræmia where there is a possibility of some pathologic involvement of the other kidney, which, in some cases, cannot be diagnosticated before the operation.

This opinion is also accepted by Geiss, who, out of 18 cases of hydronephrosis upon which he operated, only twice performed primary nephrectomy and five times secondary nephrectomy. Nephrotomy was done on all the other patients, and in nine of them a complete cure resulted. There was one death after primary nephrectomy.

An exactly diametrically opposed opinion is upheld by Jeannel, who, on both statistics and theoretical conclusions, believes that only in the most infrequent cases can a cure of a large hydronephrotic sac be obtained by nephrotomy, and as secondary nephrectomy is always more difficult than a primary one, as it always has a more unfavorable prognosis, he concludes that, under these circumstances, primary nephrectomy is proper, provided that the remaining kidney is functionally healthy. Von Bergmann is also of this opinion and has performed nephrectomy twenty-one times for hydronephrosis.

Israel and Güterbock take an intermediary position in this question. They advise nephrectomy in long-standing large hydronephroses, in which a very large amount of renal parenchyma has become transformed into a hard fibrous sac. They point out, and correctly so, that fistula arises when the renal parenchyma has been allowed to remain, so that nephrectomy has to be ultimately resorted to to do away with this serious complication.

Referring now to plastic operations, it will be seen that when marked anomalies exist which have caused the development of the hydronephrosis, if they are corrected by a plastic operation the kidney may be saved.

Küster has recorded a case of a thirteen year old boy upon whom a nephrotomy had been done for a left-sided hydronephrosis. A fistula persisted after the operation, which could not be made to close, and, as the right kidney was absent, all the urine was discharged through the fistula. Therefore, Küster first endeavored to reach the ureter through the fistula by the passage of a sound. As this did not succeed, he exposed the anterior aspect of the kidney, which bulged forward, and opened the sac. When the interior of the sac was reached through the incision, the course of the ureter became visible and was found to pass upwards along the posterior wall of the sac for a few centimetres and opened into the renal pelvis by a slit-like orifice. Passing the sound through the ureter, a stricture was reached about 3 centimetres below the sac, which just allowed the passage of the very finest sound. The stenosed portion of the ureter was removed including that portion up to the renal sac, and the lower extremity of the ureter was sutured to the posterior wall of the sac. After a very few hours bloody urine was voided by the bladder and four months later the larger portion of urine was excreted normally. Küster believes that this case is sufficient evidence to show that such instances of hydronephrosis caused by stricture of the ureter may be cured.

Israel obtained a cure of a hydronephrosis in a male child eleven years of age by means of a plastic operation. A well-developed valve in the lower portion of the ureteral orifice opening into the posterior wall of the renal pelvis was found to be the causative factor. This was freed in the middle, both halves were pulled apart, and in the angle of the incision the mucous membrane of the ureter was united by suture with the mucosa of the renal pelvis. On each of the separated halves of the valve the mucosa of the ureter was sutured to the mucosa of the renal pelvis. The latter was left opened and drained and four weeks after the interference the patient was discharged cured.

Morris also reports several cases of plastic operations which were performed for stenosis and valve formations in the ureter, and calls atten-

tion to the importance of such operations, particularly when stenosis of the ureter is present. In his opinion, the interferences required are: catheterism of the ureters, colpo-ureterostomy, implantation of the ureter, nephro-ureterectomy and ureterotomy.

Many other successful plastic operations have been performed by Kelley and others, but these have been upon the adult, so no further reference will be made to them.

In discussing the operative treatment of hydronephrosis, it should be recalled that in many cases in children the operation is first indicated for diagnostic purposes and this undoubtedly is quite proper. As to exploratory puncture, attention should be given to the fact that it may give rise to septic peritonitis on account of the escape of the contents of the cyst into the abdominal cavity, and this has occurred in more than one instance. I am aware of 10 case reports where death occurred after exploratory puncture of a hydronephrotic sac and, therefore, believe that this procedure is to be condemned.

The relative frequency of the escape of the cystic contents into the abdominal cavity through an opening so fine as that produced by the needle may be explained from the fact that in many cases the contents are composed of a very thin, urinous fluid.

To sum up the treatment of primary hydronephrosis in children, it may be said that surgical interference is indicated under all circumstances. If a portion of the renal parenchyma can be saved I believe that nephrotomy, followed by drainage, is justifiable, but when the secreting portion of the kidney has been destroyed, primary nephrectomy should be undertaken. It goes without saying that this can only be considered when one is certain that the functional condition of the remaining kidney is perfect. Occasionally, as in the case here reported, much difficulty may be experienced from the presence of numerous, tough adhesions, but by working carefully through a long extraperitoneal incision, such as employed in the case here reported, where plenty of room may be obtained, the operation may usually be carried out to a satisfactory conclusion.

Pathology.—Having discussed the treatment, I would now like to consider briefly the question of the pathology of

primary hydronephrosis, particularly as encountered in childhood. There is no doubt but that this lesion when encountered in adult life may, in many instances, have a congenital origin, because the conditions found can easily be traced back to an abnormal development at birth. Some writers even go so far as to consider all instances of primary hydronephrosis as a result of some anomaly of the urinary tract having a congenital origin.

The degree of dilatation of the renal pelvis depends entirely upon the extent of the obstruction offered to the flow of urine. If this is of mild degree the dilatation of the renal pelvis will be only moderate. This will then produce a flattening of the papillæ and dilatation of the cortex. A more marked dilatation will cause compression of the cortex, so that the uriniferous canals, as well as the glomeruli, become flattened, and thus atrophy of the latter is not infrequently brought about. All these changes are accompanied by a hypertrophic overgrowth of the connective tissue, and finally the sac may reach such a degree as to contain several litres of fluid.

A hydronephrosis may not always result in this cystic dilatation, for one not infrequently encounters a congenital hydronephrosis combined with cystic degeneration of the kidney. This type, however, is to be distinctly distinguished from a simple primary hydronephrosis. Although the clinical differentiation between these affections is a difficult affair, the pathologic finding is very different and the causative factor is not uniform. Macroscopically cystic degeneration of the kidney differs from a primary hydronephrosis in that the kidney is not transformed into a single large cyst, but is converted into a number of small cysts, varying from the size of a walnut to an apple, while microscopically atresia of the papillæ is found, the cause of which has been supposed to be an intrauterine inflammation. On account of the distention and congestion arising in the uriniferous canals, a cystic enlargement results within them, which then develops into a cystic kidney. On the other hand, cystic transformation of the kidney resulting from a hydronephrosis is merely due to pressure of the pent up urine in the renal pelvis.

Many cases of primary cystic kidney due to an obstruction of the ureter or urethra, which, in the first place, produces a dilatation of the renal pelvis, have been reported. For example, Von Mutach in his paper entitled "Genese der Cystenniere," which appeared in 1895 in *Virchow's Archive,* describes a case of congenital cystic kidney with obstruction of the urethra and a hydronephrotic renal pelvis, and another one in which he found occlusion of the ureters. It is evident from the report of these cases that in the first one a hydronephrosis developed, followed by a transformation of the kidney into a single large sac due to an obstruction in the urethra, while in the second case a so-called congenital cystic kidney developed as a secondary process to the dilatation of the kidney.

If Virchow's theory of intra-uterine inflammation be accepted, it might be possible to find in this the cause of stricture of the ureters, as well as an atresia of the renal papillæ. In those cases where occlusion of the ureters is found accompanied by a congenital cystic kidney with a dilated renal pelvis, one could explain the process as follows: as the result of an intra-uterine inflammatory process, the exact cause of which is not as yet fully explained, an atresia of the ureters occurs which gives rise to distention of the renal pelvis, and then, as a result of the back pressure and ascending extension of the inflammatory process, atresia of the papillæ arises, during the development of which cystic disease of the kidney occurs. It could then be taken for granted that, in those instances in which there is a complete occlusion of the ureter, a hydronephrotic dilatation of the renal pelvis with the above-mentioned resulting lesions is found, which is not in the true sense of the word a congenital cystic kidney. The inflammatory process is confined in the first place to the ureters without having extended to the papillæ.

Other writers attribute the obstruction in the ureter to a disturbance in the development and not to an inflammatory process, while others are of the opinion that the hydronephrosis is the direct causal factor of the cystic kidney. If this be accepted, it remains unexplained why, when a hydronephrosis

is present, the renal parenchyma should transform into a cystic sac with atrophy of the kidney structures, because the latter condition is found quite as often when the excretory urinary tract is perfectly normal, so that the reason for its production must still be sought for in other circumstances. Thus, a few writers believe it to be due to some developmental interference, while still others are inclined to assume that these cystic kidneys are nothing less than a cystadenoma.

Referring now to the causes of the production of a primary hydronephrosis, it may be said that occlusion at some point of the excretory urinary tract is only one among many, but there must always be an obstruction to the flow of urine at some point which leads to distention of the renal pelvis, first among these to be mentioned being a partial or complete occlusion of the ureter or urethra. Several cases have been recorded where a partial or complete obstruction of the urethra has resulted in a dilatation of the renal pelvis, which naturally involved both kidneys.

Thus Billard found hydronephrotic changes in a newly-born infant which resulted from an obliteration of the urethra situated just behind the external meatus. A case of a child fourteen days old having complete retention of urine from birth has been reported by Schuchardt; catheterism revealed an obstruction in the urethra which was finally overcome by repeated passage of the catheter. The child had a distended abdomen when born, so that it is evident that a hydronephrosis was at that time present. It died, and autopsy revealed an extreme dilatation of the bladder, ureters, and renal pelves. It is evident from all this that even a mild obstruction of the urethra in the newly-born may in reality be a most serious affair.

Rindfleisch has recorded an interesting case of occlusion of the urethra which resulted in hypertrophy of the bladder and hydronephrosis. The subject was a male child five weeks old who developed pleuritis, but had given no evidence of any symptoms in the urinary tract. Autopsy showed a soft elastic tumor the size of a small pea at the caput gallinaginis. The sinus prostaticus was widely patent, but no opening of the ejaculatory ducts could be found. On the other hand, where these openings should have been there was a dilatation and thickening of the blind end of the spermatic cord and this had caused the swelling of the caput and had displaced the lumen of the urethra so that an occlusion resulted.

That slight stricture of the urethra may have a very unfortunate result is made evident by a case recorded by James, in which an eight-year-old boy suffered for several years with urinary symptoms and finally died in coma. Autopsy showed that the bladder wall was greatly hypertrophied,

while the renal pelvis on both sides was greatly distended and all these changes had arisen from a tight phimosis. Mr. D'Arcy Power has also called attention to this cause of hydronephrosis in his book on "The Surgical Diseases of Children."

Schuchardt has attempted to explain these extensive changes in the renal pelvis, as follows: in children he maintains that the muscular structures of the bladder are not sufficiently strong to overcome the increased demands, the voluntary impulse to void urine is not so developed, and consequently the bladder may become readily overdistended with much greater ease than in the adult. Now, since the vesical walls are much thinner than in the adult, the ureteral orifices are relatively large, and the valvular mechanism cannot be accomplished with as great ease as in the adult; consequently, a retention of the urine in the bladder and ureters may easily result, and finally from back pressure dilatation of the renal pelves is brought about.

Far more frequently than stenosis or atresia of the urethra, ureteral anomalies result in dilatation of the renal pelvis followed by all its consequences, and may be unilateral or bilateral. The fact that, in all likelihood, every case of primary hydronephrosis is the result of some congenital defect in the excretory urinary tract, renders it apparent that a hydronephrosis may occur in both kidneys quite as frequently as in one. In the first place, we may find a stenosis of the ureter or some abnormal position, such as torsion or kinks, or a malinsertion of the ureter into the renal pelvis, which results in the well-known valve formations. Then we may have two ureters, all of which may produce retention of the urine with its accompanying dilatation of the renal pelvis.

Relative to atresia of the ureter, a unique case has been put on record by Henoch. In a child six weeks of age a bilateral hydronephrosis was found which was the result of a complete cicatricial closure of both ureters. It is evident that the occlusion was not complete, because the infant voided urine up to the sixth week of life, so that it was assumed that, since the parenchyma of the right kidney was more markedly atrophic than the left one, the closure of the right ureter and the hydronephrosis on the same side was congenital, and as a result of the compensation hyper-

trophy of the left kidney, its pelvis became the seat of an inflammatory process which caused occlusion of the left ureter, followed by a secondary hydronephrosis.

Foerster has related a case where there was atresia of the rectum and in the place of the left ureter there was a solid cord which ran from a hydronephrotic kidney to the bladder. In this case the obliteration of the ureter can be most probably accounted for by some developmental disturbance and not from an inflammatory process, which may be assumed on account of the presence of another malformation, consisting of a rectal atresia. In a child eighteen months old Gruneberg found a complete occlusion of the ureter at its vesical end which had given rise to a hydronephrosis on the right side.

That partial obstruction of the ureters may give rise to the same results as when this is complete is made evident by three cases of primary hydronephrosis reported by Sudeck; in two a ureteral stricture was found at the renal pelvis end of the duct, and in the third at its entrance into the bladder.

It is still a much discussed question as to how the partial or total atresia of the ureter can be explained by the theory of intra-uterine or postfetal inflammation, resulting in the interference in the development, or by other processes. For example, Klebs believes that this may result in slight adhesion of the epithelial surfaces, which in the embryonal stage come into contact with each other.

English, who has undertaken a large number of careful investigations to ascertain the causes of stenosis and atresia of the ureter, concludes that there are three points of narrowing in the normal ureter, namely, where the canal leaves the renal pelvis, at some distance below this point, and where the ureter passes through the bladder wall. In later writings he compares the occlusions with these normally narrowed points, and finds that there is a surprising sameness of occurrence in the localization of these strictures, particularly when the obliteration is partial. Out of 65 ureteral strictures he found that the process only occurred in three instances in the middle of the ureter, while in 34 others it was present at the upper, and in 28 in the lower end of the ureter. From these facts he concludes that a pathologic stenosis is the result of some disturbance in the development of the physiological narrowings of the ureter.

Several cases have been reported of anomalies in the development of the ureters where there were two ureters, but here the hydronephrosis was only partial.

Wrany has recorded two cases of partial hydronephrosis with a double ureter. In the first one, the enlarged right kidney possessed two pelves, each with its own ureter, and only one of the pelves was dilated. Its ureter opened into the fundus of the bladder opposite to the vesical orifice of its fellow ureter, and where it entered the bladder it was surrounded by two folds, which, in all probability, caused obstruction to the free flow of the urine. The other ureter and renal pelvis on the same side were quite normal. In the second case, the left kidney had three pelves each with its own ureter. The ureters of the two lower pelves united soon after leaving them and showed no anomalous condition; but at the entrance into the bladder of the third ureter a sac formed by two layers of mucous membrane was found which had caused a dilatation of this ureter and its renal pelvis.

In a newly-born girl Osterloh found a double ureter running from the left kidney, the upper one entering behind the bladder into a blind sac, which had caused dilatation of the ureter and its corresponding renal pelvis. Lilienfeld has also recorded a case of double ureter running off from the right kidney; one was perfectly normal, while the second was represented by a diverticulum near its entrance into the bladder. The upper end was also obliterated, and as a result of a hydronephrosis the corresponding portion of the kidney had become destroyed. Zaluski has reported a similar case where one of two ureters belonging to the right kidney had a stenosis and its corresponding renal pelvis was much enlarged.

These cases which are taken haphazard from the literature demonstrate that such a partial hydronephrosis, which is not apt to be found where the kidney has a single ureter, can be traced to two principal conditions, namely, to the deeper opening of one ureter into the bladder, and secondly to the formation of a diverticulum at its vesical entrance. Why the former condition leads to a hydronephrosis and how the development of the diverticulum occurs, English has attempted to explain as follows: when the opening of the ureter into the bladder is too deep, its orifice sags in the region of the vesical sphincter, because the ureter must of necessity penetrate a thicker bladder wall. Consequently, when micturition takes place, compression of the ureter occurs from contraction of the fibres of the detrusor urinæ which results in a closure of that

portion of the ureter lying above its vesical orifice. From this there results a retention of urine in the ureter, followed by dilatation of the renal pelvis from back pressure.

As to the formation of a diverticulum, English assumes that in these cases that portion of the ureter lying immediately below the vesical mucosa is wider than that lying in the muscular layer and opens into the bladder by a very narrow orifice in most cases. Thus an obstruction is formed, a distention of the mucous membrane of the ureter situated in the muscular layer of the bladder takes place, which offers only slight resistance, and in this way a vesical diverticulum results.

A peculiar type of hydronephrosis, a so-called intermittent form, characterized by an occasional increase in size of the renal region, is occasionally met with when the ureter becomes kinked. The alternating increase and decrease in size of the renal region is the result of an alternating filling and emptying of the renal pelvis. When the renal pelvis has reached a certain degree of distention, the kink in the ureter is overcome by intrapelvic distention and the urine is discharged through the ureter. Landau has endeavored to explain how an intermittent hydronephrosis finally becomes a permanent one. The urine becomes retained in the renal pelvis when the patient is in an upright position and cannot be eliminated until the bending has been done away with. When this has occurred from pressure of the urine in the overdistended pelvis, the kinking again soon occurs and the renal pelvis again becomes filled. If this process of filling and emptying of the renal pelvis is frequently repeated, the elasticity of the latter becomes affected and more and more urine will be retained, so that, finally, the renal pelvis is so greatly dilated that it involves the ureter. The discharge of urine in the upright position then becomes impossible, and when the patient is lying down it can only occur when the kink in the ureter has been undone, which frequently does not take place. These kinks in the ureter are in many cases a secondary affair, particularly in those cases where they result from a movable kidney, but sometimes they are primary, as the following examples illustrate.

In a male who had been ill with symptoms of hemorrhagic nephritis, Weigert found the right kidney transformed into a cyst the size of a child's head, its walls measuring about 2 mm. thick. From the inner and lower portion of the cyst the ureter passed along the lower surface and then suddenly became bent at a right angle and passed downwards to the bladder, its lumen progressively diminishing. As there was no inflammatory change where the bend occurred, the latter was considered as a congenital defect. Roberts has recorded the case of a male, twenty years of age, who presented symptoms of intermittent hydronephrosis and finally died from uræmia. Both kidneys were found transformed into a sac filled with urinous fluid. The left ureter was stenosed near its upper orifice and entered the renal pelvis at a right angle, so that only forcible pressure on the tumor could produce a straightening out of the ureter and allow the urine to flow through. The right kidney, which was represented by a cyst, possessed two arteries, one lying over the other and coming from the aorta. The upper one, after supplying the suprarenal artery, went to the upper portion of the hilum of the kidney, while the lower one soon after its origin divided into two branches, one of which passed to the hilum and the other downwards to the perirenal fat and crossed the ureter near its upper extremity. The cause of the hydronephrosis of the left kidney was due to a stenosis and bend of the ureter, whereas, on the right side, compression of the ureter by a supernumerary renal artery caused the dilatation of the renal pelvis. As this case teaches, it may happen, although infrequently, that a supernumerary artery may produce hydronephrosis by compression of the ureter. I am only aware of two other similar instances. In one case reported by Küssmaul, the lower of the two arteries crossed the ureter at its point of exit from the renal pelvis and produced a fair amount of compression which resulted in a hydronephrosis. In the second case, reported by Rokitanski, the compression was caused by the renal artery at the upper extremity of the renal hilum, the vessel descending into the lower portion and crossing the ureter, and by compression of the latter hydronephrosis resulted.

Most peculiar are those cases where the ureter is patent and still a hydronephrosis is present. Such cases are occasionally met with, and in all of them a valvular obstruction has been found produced by a fold of the mucosa. Mendelsohn has attempted to explain as a reason for the formation of these valves, an abnormal insertion of the ureter into the renal pelvis, believing that the insertion takes place too high up. As a result of this high attachment, he points out that a portion of the renal pelvis under the point of attachment of the ureter must first become filled with urine before it can make its exit through the ureteral orifice. Consequently, dilatation of the renal pelvis results. By constant filling up of the renal pelvis

it becomes pressed against the ureteral walls by the gravity and pressure of the collected urine, thus forming an additional obstruction for the exit of the urine, in other words the mechanism is entirely a valvular one. Pathologists have looked upon this valve formation as congenital and not a secondary process, and as resulting from congenital developmental anomalies. They have been considered as a malformation whose development, according to Klebs's opinion, probably may be looked for at the point of exit of the ureter from the renal pelvis. Küster accounts for the development of these valves by an inflammatory swelling of the mucosa of the renal pelvis, while Simon believes that they must be looked upon as a result and not the cause of the hydronephrosis. He found at autopsy another obstruction in the ureter, which he considered the primary cause of the hydronephrosis, and believes that the development of the valves results from a twist which the kidney undergoes as a result of the distention of its pelvis, so that the pelvic end of the ureter becomes displaced.

Ayrer reports such a case of hydronephrosis, the cause of which was a valve formation in the ureter. The patient, eighteen years old, presented a kidney which had become transformed into a sac, its walls varying from 2 to 3 mm. in thickness and containing about 7 litres of a thick yellow fluid. At the point where the ureter opened into the cyst there was a duplication of the mucous membrane, which protruded into the lumen of the ureter like a valve. There was a kind of bend of the ureter causing a lateral displacement, which was produced by a band of connective tissue accompanying the ureter from its origin to a point about 1.5 cm. below the cyst. Ayrer believed that the latter was the cause of the valve formation. In a female forty years of age in whom a diagnosis of ovarian tumor had been made, Wölfler discovered at operation a hydronephrosis, which was found to be produced by a pocket formed in the cyst wall at a point where the ureter entered into the pelvis and formed a crescentic valve. He also examined the ureters of 100 infants and found, in 20 per cent., at a small distance from the opening of the ureter into the renal pelvis, from one to several folds in the mucous membrane, varying in size from 1 to 5 mm., and he consequently thought that a valve could be formed by adhesion of two such folds. A labiate opening of the right ureter into the renal pelvis had produced a hydronephrosis in a case recorded by Giraud, as no other cause for the production of the latter could be found. Reclus has described a case of bilateral hydronephrosis, in which the ureter on the left side up to the bladder was permeable, presenting no bend or other malformation, while,

on the right side, only a few fibrous bands were found which had caused compression and dilatation of the ureter. The bladder and urethra presented no defect. Bernard, in four cases of hydronephrosis in nursing infants, found uric acid sand as the only cause for the lesion and is of the opinion that this may explain the pathology of the development of many cases of hydronephrosis where the cause is vague.

Edes reports several such instances of hydronephrosis, followed by atrophy of the kidney, in children in whom not the slightest obstruction to the flow of urine could be found. In these children during life involuntary micturition occurred, while postmortem showed hypertrophy of the bladder walls and other signs of cystitis. He also found several other examples recorded by others, and he believed that, in these cases, as a result of frequent contraction of the bladder produced by cystitis, a back pressure took place which brought about dilatation of the ureter and renal pelvis.

Levin and Goldschmidt, in a very interesting contribution published in 1893, in *Virchow's Archive,* entitled "Versuche uber die Beziehungen zwischen Blase, Harnleiter und Nierenbecken," on the strength of several successful experiments in rabbits, assumed that these forms of hydronephrosis in which no obstruction to excretion can be found may be attributed to a return flow of urine from the bladder into the ureter and from here to the kidney pelvis. Up to the time of their studies, it had been supposed that as a result of the oblique opening of the ureter into the bladder, a return flow of urine into the ureter was an impossibility, but these writers have proven experimentally, both by injections of fluid into the bladder and by artificial retention of urine by ligation of the urethra, that an acute reflux of the contents of the bladder can easily be produced. This reflux rushes rapidly into the renal pelvis, at first paralyzing its contractility from the great dilatation of the ureter, and at length produces the most varied abnormal movements of the ureter with the renal pelvis, such as antiperistaltic and spasmodic contractions. This result of their experiments led them to the explanation of cases of hydronephrosis which were produced by an irritation of the kidney, with a constant desire to empty the renal pelvis so that hypertrophy finally results and afterwards dilatation, a theory which would appear to be verified by the cases reported by Edes. On account of the permanent contraction of the bladder and ureter, these authors furthermore concluded that the renal pelvis became filled with urine and from this circumstance became distended.

If we now sum up the causative factors of primary hydronephrosis, one must place at the head of the list certain anomalies of the ureter, and secondly others occurring in the remaining portions of the urinary tract, such as the bladder, prostate, and urethra, which are usually developed during intra-uterine life and, consequently, it may be assumed that all primary hydronephroses have a congenital origin. It is quite true that

English claims that the obstruction in the ureter, such as found in adults, is never present to the same extent at birth, but that, on the contrary, certain changes take place in them from which occlusion results. However, the type of obstruction is probably the same at birth, only it is necessary that other factors should intervene to cause retention of the urine, otherwise it would be impossible to understand why in one case these anomalies should result in a hydronephrosis, while in other cases a perfectly normal kidney is found, although these anomalies are present in some portion of the urinary tract.

RECENT DEVELOPMENTS IN PYELOGRAPHY.*

BY WILLIAM F. BRAASCH, M.D.,

OF ROCHESTER, MINNESOTA,

Physician to St. Mary's Hospital.

PYELOGRAPHY is not a new subject. The idea of injecting a substance which is impenetrable to the Röntgen ray into different parts of the urinary tract has for a long time been suggested by various observers.

To Professor Voelcker of Heidelberg must be given the credit of first demonstrating a radiogram of an injected renal pelvis in the living, and of calling attention to some of the possibilities of the method. For some reason the method did not arouse any general interest and nothing more was heard from it until within the last year or two.

So far as I have observed, the plates which had been published at the time I commenced my investigations almost two years ago showed no other condition than that of the normal pelvis and hydronephrosis. In a paper read before the United States Clinical Surgical Society last October and published in the ANNALS OF SURGERY for April, 1910, I was able to demonstrate plates showing a variety of conditions in the urinary tract, bringing out various associated data. Recognizing the practical value of the method, we have since employed it almost daily in St. Mary's Hospital. The illustrations for this article will be selected from several hundred collargol radiographs which we have made thus far.

Technic.—Following Professor Voelcker's suggestion, we have used collargol as the injected medium in most of our figures. The silver salt casts a definite shadow, and furthermore has the advantage that it can be used in weak solutions. A solution as low as 2 per cent. will often outline the renal pelvis quite clearly, and it can be injected without fear of harmful results. That it is a non-irritant is shown by its well-

* Read before the American Urological Society, June, 1910.

known use in intravenous injections. At operations we have repeatedly found collargol retained in the renal pelvis into which it had been injected several weeks before. It seldom causes more than a slight temporary irritation when injected. It does not interfere with primary union in operation wounds. Ordinarily we use a 10 or 15 per cent. solution, although a 5 per cent. solution suffices to cast a fair shadow. The stronger solutions generally cast a denser shadow, and retaining fluids in a dilated pelvis will often dilute even a 15 per cent. solution considerably. The amount injected will, of course, depend upon the size of the pelvis; a large hydronephrosis will contain several ounces without harm.

The Normal Pelvis.—As I have already stated, the normal pelvis will vary much in size and contour. In fact, in order to correctly interpret abnormality of the pelvic outline, one must become familiar with the wide range of pelvic contour. Marked colic, brought on by overdistention, will cause contracture of the normal pelvis and only a small slit will remain. As a rule a severe colic can be obviated by carefully injecting the fluid while the radiograph is being made. Without going more fully into the subject, I will show two extremes in the pelvic contour. Both were made in females with indefinite tumors in the right hypochondrium which, at operation, proved to be due to distended gall-bladder, while the kidneys were found normal.

Fig. 1 shows the slit-like pelvis in a normal kidney obtained immediately after injecting 3 c.c. of collargol, which caused a severe colic and which might easily be interpreted as the remnant of a pelvis encroached upon by surrounding tumor tissue.

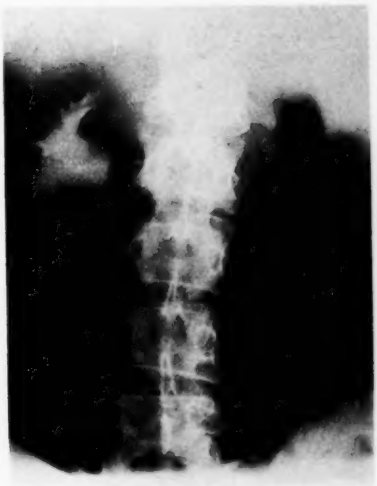
Fig. 2 shows a large pelvis in a normal kidney with a content of 18 c.c. The pelvis, while of fair size, was not found abnormally large nor pathologic in any way. This is one of several figures which we have, showing a large normal pelvis containing from 15 to 25 c.c. collargol.

The Dilated Pelvis.—As before stated, the overdistention method, if correctly employed, is most accurate in determining

FIG. 1.

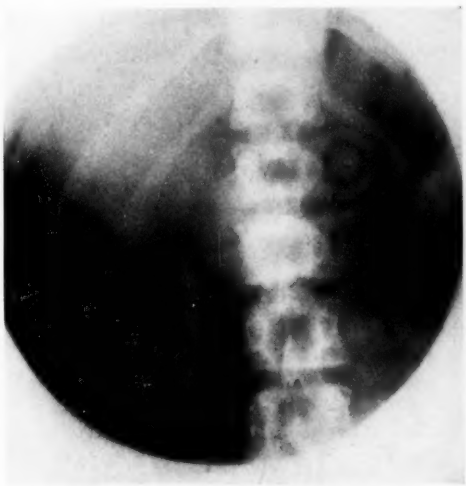
Normal pelvis in actual colic after injecting 3 c.c.

FIG. 2.



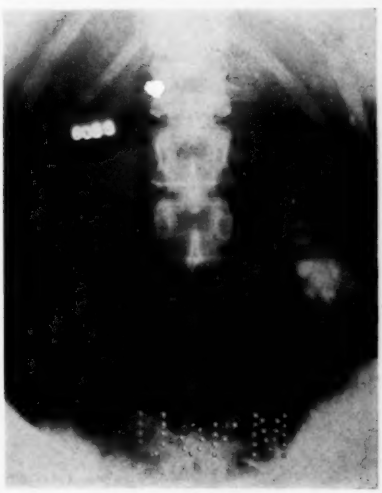
Normal pelvis with capacity of 18 c.c.

FIG. 3.



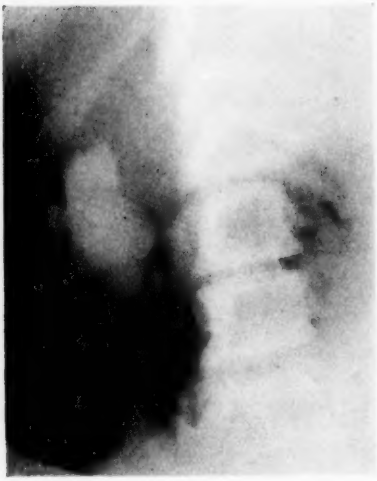
A moderate hydronephrosis partially distended because of impassable ureteral obstruction.

FIG. 4.



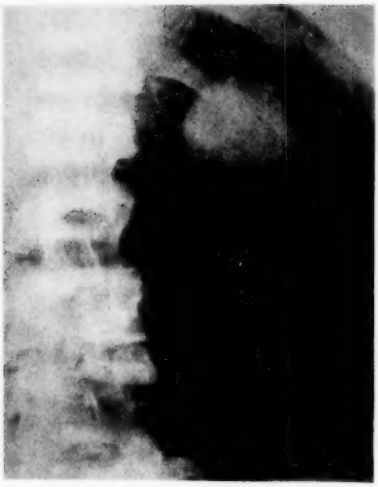
A moderate hydronephrosis largely within the renal substance.

FIG. 5.



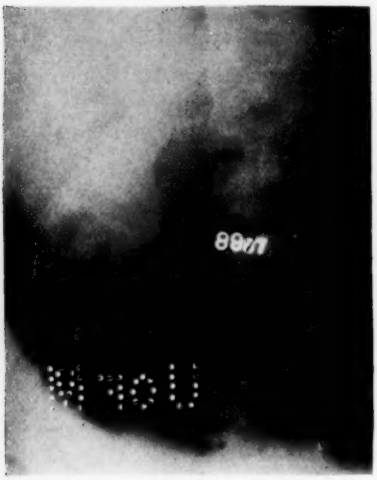
A retention or mechanical dilation of the renal pelvis.

FIG. 6.



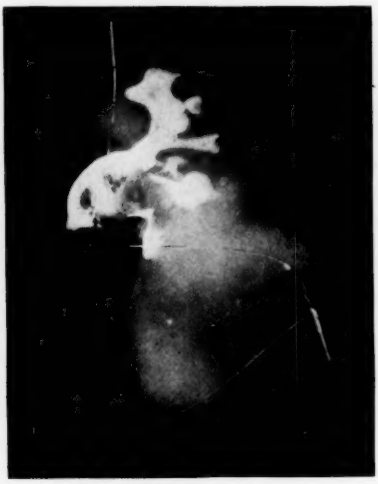
An inflammatory dilation of the renal pelvis.

FIG. 7.



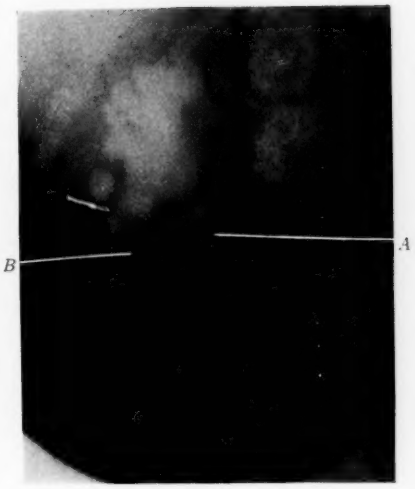
A combination of mechanical and inflammatory dilation.

FIG. 8.



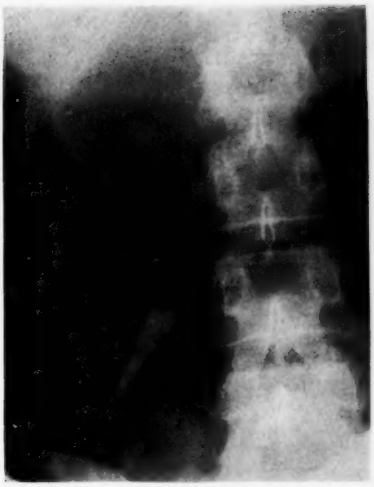
The pelvis invaded by tumor tissue, showing but little space remaining.

FIG. 9.



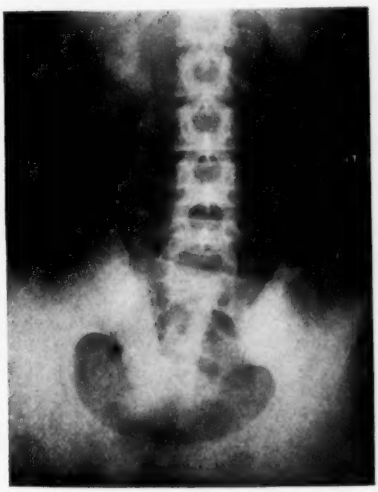
A and *B*, stones at the ureteropelvic juncture and in a lower calyx respectively. Also a retention hydronephrosis with but little functionating kidney.

FIG. 10.



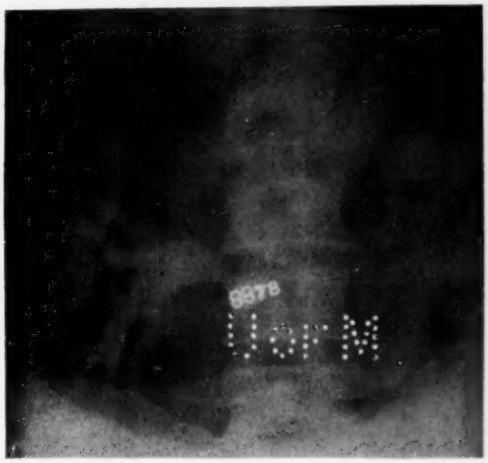
The upper shadow is that of a gall-stone; the lower that of a normal pelvis. The distance between identifies the former as extrarenal.

FIG. 11.



A hydro-ureter extending from the bladder to a hydronephrotic pelvis.

FIG. 12.



The irregular retracted pelvis occurring in a bilateral cystic kidney.

the existence and extent of a dilated pelvis, providing that the catheter is able to pass the etiological ureteral obstruction. However, it is always more satisfactory and of great confirmatory value, at least, to visibly demonstrate the dilatation. Furthermore, when the catheter meets an impassable obstruction, enough collargol can frequently be injected past the constriction to outline the pelvis enlargement quite definitely. Fig. 3 illustrates a moderate pelvis outlined under such conditions. With the overdistention method the condition could not be demonstrated because of the immediate return flow of most of the injected fluid. On the other hand, there are undoubtedly hydronephroses which will not appear as such in the injected radiograph. This is particularly true when the dilation is largely confined within the contour of the kidney, where for some reason the free pelvic wall did not yield. This is graphically illustrated in Fig. 4.

The etiological factors, mechanical or inflammatory, are usually quite clearly defined in the pelvic outline. The mechanical or retention dilation is marked by regularity,—the even lines of the pelvic wall and the rounded ends of the dilated calyces (Fig. 5). The inflammatory pelvis, on the other hand, is irregular in outline (Fig. 6) and often with detached shadows caused by cortical abscesses connected with the pelvis. Occasionally we will get a combination of both factors. In Fig. 7 we have illustrated a retention pelvis as the result of some peripelvic inflammatory process. The regular dilation of the calyces is varied by the rather irregular outline of the free pelvic wall.

Tumor Deformity.—On account of the wide variation of size and shape of the normal renopelvic outline, we must be careful in interpreting a pelvic outline as pathologic. As previously stated, deformity of the renal pelvis caused by tumor will result from retraction of its whole or part of the tumor tissue, or from encroachment of the tumor in the pelvic space. Wilson [1] has demonstrated that in most renal neoplasms

[1] Wilson: Old Dominion Journal of Medicine and Surgery, No. 4, April, 1910.

a marked deformity of the renal pelvis is visible in a cross-section. In a previous paper I published two collargol plates showing this deformity prior to operation. Naturally the pelvic outline must vary widely from the normal in order to be recognized as a deformity. In case of tumor retraction the pelvis may be irregularly large, or a single calyx may be distended and retracted even three or four inches. Again the pelvis at the ureteropelvic juncture may be abnormally broad or square in outline. In case of tumor encroachment, but very little of the pelvic space must remain in order to be able to recognize actual deformity (possibly one or two thin streaks), or if the pelvic space is obliterated by the tumor, nothing would be visible except the collargol within the adjacent catheter. In Fig. 8 but two narrow shadows, one on either side of the encroaching tumor, show all that is left of the pelvis. Thin streaks spreading out into the kidney tissue may be all that is left of the retracted calyces. An interesting feature in such cases is, that injected collargol does not readily drain away, as can be demonstrated by radiography several days later, when shadows of the retained collargol will often be shown. Another point of corroborative value in suspected tumor of the kidney is to find the pelvis shoved over in unusual positions. In one of our figures it was found lying over the vertebral column. However, it will not be possible to make a radiographic demonstration of distinct pelvic deformity in every renal neoplasm. A large number, possibly a third of them, will not have enough deformity to be of diagnostic value. Again, because of obstruction to the ureteral catheter from various abnormalities in the course of the ureter, external pressure, or even ureteric metastasis, it will often be found impossible to reach the pelvis with the injected fluid. It has been our experience that in order to secure the best results, one should employ a fairly stiff catheter of as large a calibre as possible and radiograph while injecting the collargol.

Localization of Renal Shadows.—While it is true that with

good radiographic technic and apparatus, the kidney shadow can very often be fairly well outlined, nevertheless, for technical reasons in the course of routine examination, it will frequently happen that the renal outline is quite indefinite or will not show at all. Furthermore, distended gall-bladders, large abnormal livers, abdominal tumors, a large fatty capsule, etc., often obscure the kidney shadow and give misleading ideas of the exact outline and position. While it is very often possible to approximately localize renal stones in the kidney shadow if well defined, we have found that it can be done more accurately with the aid of collargol. A small stone deep in the calyx may, in the unaided radiograph, appear to be in the cortex, while in the collargol plate the cortical stone should usually be seen quite distinct from the pelvic shadow and its relative position in the parenchyma quite accurately ascertained. Pelvic stones will either be obscured entirely by the collargol shadow or show faintly through it. It is true that cortical stones just beyond a calyx may, in exceptional cases, appear to be continuous with the calyx shadow and in it. Furthermore, dilated ends of calyces may appear detached and may simulate cortical stones. Again, a stone in the lateral renal cortex in direct line with the pelvis might appear to be within the pelvis shadow, depending upon the comparative density of the stone and pelvic shadow. Such a lateral position is, however, rather infrequent. If any doubt exists, its position can be ascertained by making the radiograph at various angles. Another possible source of confusion may arise when extrarenal shadows are in direct line with the pelvis and may appear included within it. Nevertheless the stone can be definitely localized by means of the injected radiograph in most cases, which is of much aid to the operator (Fig. 9).

Differentiation of Extrarenal Shadows.—Although the extrarenal shadows can usually be identified as such, it is sometimes difficult to do so. The relation of the injected renal pelvis to a neighboring shadow is often an aid to its identification. This is particularly true in the differentiation of gall-

stone shadows. With the development of radiographic technic, gall-stone shadows are being found more frequently. Peculiarities in the shadow will often assist in identifying them. When in a normal position, the distance between the gall-stone shadow and the injected renal pelvis should usually identify them as being extrarenal (Fig. 10). However, when the gall-bladder lies low and overlaps the kidney area, gall-stone shadows appear to be intrarenal, but peculiarities in their relation to the injected pelvis, together with cystoscopic data, should suffice to identify them in most instances. We have been endeavoring recently to employ stereoscopic collargol radiographs in their differentiation.

Ureteral Obstruction.—Obstruction to the ureteral catheter may be physiological and difficult to differentiate clinically from the pathological. An actual obstruction which occludes enough of the ureteral lumen to hinder the passage of the catheter usually causes enough urinary retention to produce more or less dilation of the renal pelvis and ureter above. This can be demonstrated frequently in a collargol radiograph. The method is particularly available in the diagnosis of ureteral stone, which, even with the best technic, will occasionally be missed by the radiograph. At times the obstruction is such that not even enough of the injected medium can pass to cast a shadow. More often, however, enough can be forced by to outline the dilated ureter and pelvis above, even though the catheter itself is blocked. Should the catheter pass the obstruction, in order to demonstrate the ureteral dilation, it is advisable to withdraw the catheter almost to the obstruction and then inject. We have several plates where ureteral dilation involves but a part of the ureter above the obstruction. Again, another plate shows but little dilation of the ureter above the obstruction, but considerable dilation of the pelvis. A peculiarity of low-lying ureteral obstruction, and particularly with long-standing or congenital obstruction, is frequently noted in that the first part of the ureter, extending from the ureteropelvic juncture to the first point of narrowing, will often remain undilated even though the remainder of

the ureter is much distended (Fig. 11). Because of the difficulty of fully distending a dilated ureter, it may be impossible to outline the full extent of the dilatation. With extreme ureteral dilatation one should first endeavor to partially drain the ureteral contents and then inject a heavy solution of collargol. Profuse return flow alongside the catheter in a naturally flaccid ureter may give the appearance of a moderate dilatation.

Solitary Kidney.—The pelvic outline in solitary kidney may be of diagnostic value. In a plate already published, I demonstrated the pelvis of a congenital solitary kidney. The pelvis was shown to be about twice the usual size but with normal appearing calyces. On exploration the actual size of the pelvis was found to be commensurate with the hypertrophied renal parenchyma. An acquired solitary kidney, on the other hand, when the other kidney becomes functionless, will show a pelvis normal in size and contour. The parenchyma may be double its normal size, but the pelvis remains as it was before. It may be noted with interest that neither of the two cases showed any untoward symptoms following the pelvic distention.

Renal Tuberculosis.—It often happens that a non-tuberculous pyelitis occurs with clinical symptoms, *i.e.*, bladder ulcerations and unilateral cloudy urine, all suggestive of renal tuberculosis. Again, it may happen that a renal tuberculosis infects the bladder mucosa but little, and the clinical and cystoscopic picture may resemble a local pyelitis. It is peculiarly true that a pyelitis will often show a moderate pelvic dilation in the collargol plate. On the other hand, with renal tuberculosis a cortical abscess or an irregular pelvis and an inflammatory pyonephrosis may often be outlined and of distinct value in differential diagnosis.

Cystic Kidney.—In Fig. 12 we were able to demonstrate the pelvis of a cystic kidney. A clinical diagnosis of unilateral renal tumor was evident. The pelvic outline is similar to that usually found in inflammatory pyonephrosis. The catheterized urine being clear, pyonephrosis was excluded. Diagnosis of a malignant renal tumor could hardly be made from the figure

because, (1) a pelvis of such proportions would be the result of a secondary degeneration and that such is not the case is proven by the clear urine; (2) the outline of a pelvis accompanying secondary degeneration in the malignant renal tumor would be quite different. The irregularly enlarged pelvis was found at operation to be due to retraction of a cortex resulting from diffuse cystic changes.

Congenital Malformations.—The frequency with which fused kidneys and median lying kidneys are found at operation should keep us on the lookout for them clinically. The position of a styletted catheter, as suggested by Kollischer and Schmidt, would usually suffice to determine anomalous positions in a radiograph. However, the size and shape of the pelves as well as that of the ureters can be outlined in addition to locating them by the injected radiogram. We found a very interesting condition in a plate recently; a moderately hydronephrotic pelvis was seen lying across and to the right of the second lumbar vertebra, with a dilated tortuous ureter leading to the left base of the bladder. The right renal pelvis and ureter were found to be normal in position and size. The plate, which was made stereoscopic, made the lower pelvis appear at a level much more anterior to the right and uppermost pelvis. An interpretation of the plate was rather difficult. We knew that we were dealing with a small hydronephrosis and obstructed ureter, but whether this occurred in a congenital pelvic kidney or in a fused kidney, we could not determine. Judging from the distance between the two pelves and the fact that the lower pelvis lay so far anterior to the upper one, we inferred the existence of two separate kidneys as the more probable. At operation a fused kidney seven or eight inches in length was found. It had three distinct pelves. The two upper were normal and connected with the ureters which fused above the bladder. The lowest pelvis was found to be hydronephrotic, as demonstrated in the plate, and with a dilated tortuous ureter.

Stereoscopic Radiographs.—We have recently made stereoscopic collargol radiographs which promise to give in-

teresting data. They should be of practical value in the demonstration of shadows at different levels from the injected pelvis. This should be particularly true in the differential diagnosis of overlying gall-stone shadows. Unfortunately, the shadows cast by the organs surrounding the kidney are usually too dim to be of much differential value in the stereoscope.

We have therefore proven quite conclusively that radiograph and cystoscope, working together, make it possible to demonstrate many conditions which either would fail to demonstrate alone. We have frequently found the injected radiograph to be of considerable practical value in demonstrating the following conditions: (1) normal pelvis; (2) hydronephrosis; (3) pyonephrosis; (4) pyelitis; (5) renal tuberculosis; (6) renal tumors; (7) abdominal tumor differentiation; (8) horseshoe and median lying kidneys; (9) solitary kidney (unsymmetrical); (10) cystic kidney; (11) differentiation of extrarenal shadows; (12) localization of renal shadows; (13) aid to ascertain renal functional capacity; (14) identification of ureteral obstruction; (15) hydro-ureter.

NOTE ON THE REMOVAL OF CARCINOMA OF THE FUNDUS OF THE URINARY BLADDER.

BY FRANCIS R. HAGNER, M.D.,

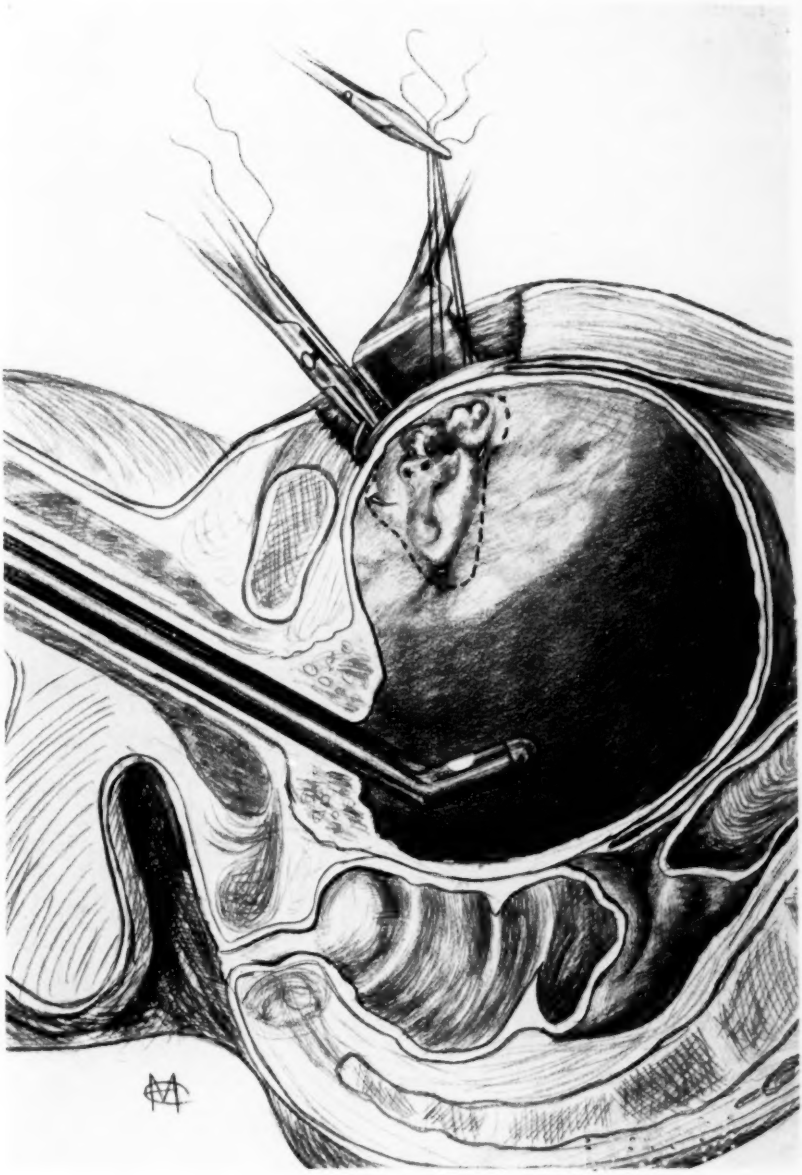
OF WASHINGTON, D. C.,

Professor of Genito-Urinary Surgery in the George Washington University.

THE fundus of the bladder is a comparatively rare location for new growths, the more common seat being the base.

It has been my fortune to have two cases of carcinoma of the fundus of the bladder under my care during the last few months, both operable. My inability to remove the friable tumor in the first case without breaking the tumor mass suggested to me the method of removal that was resorted to in the second case. By the *old* method of procedure (which was followed in the first case) just as soon as the incision was carried through the bladder wall this viscus collapsed, thereby making it impossible to determine the location for my incision on the other side of the tumor without introducing fingers into the bladder. The manipulation of the tissues by the fingers, necessary to determine lines of incision, caused a crumbling and breaking off of many small portions of the neoplasm. I believe it is generally conceded that one of the weakest features of the operative treatment of new growths of the bladder is the production of trauma to the tumor mass during its removal. It is possible, with proper care exercised, to remove tumors from the fundus and lateral walls of the bladder without the slightest traumatism to the tumor mass by the method I will describe. The operation is impracticable for tumors of the bladder *base,* which, unfortunately, is the most common situation for the growths. The following is the report of the case and description of the operation.

Male, white, forty-three years of age, was referred to me by Dr. Shaw, on March 15, 1910. Eight months ago patient began passing dark soft solid masses of tissue in his



Showing use of sutures to outline bladder tumor.

urine. From two to three days before the passage of the masses the urine would become coffee colored, but after the passage it would clear and become normal. He has passed these pieces of tissue five times during the past eight months. He had no frequency of urination or bladder pain. On his first visit he brought the last piece of tissue he had passed. This appeared to be gangrenous epithelial tissue. The man was well nourished and otherwise apparently healthy. His prostate and seminal vesicles were normal. Cystoscopic examination March 17, 1910, at Garfield Hospital, showed a bladder capacity of 350 c.c., a normal bladder mucosa except to the right of fundus, where a partially ulcerated growth, 5 c.c. in diameter, was noted, covered with black necrotic tissue. The mucous membrane was raised in several areas around the base, showing infiltration of the bladder wall by the new growth. A diagnosis of carcinoma of the anterior and right lateral wall of the bladder was made. Patient was operated on March 19.

The following is a description of the operation employed: The bladder was irrigated, and on account of bleeding, adrenalin 1 : 10,000 was instilled and allowed to remain five minutes. The bladder was then distended with 350 c.c. of salt solution, and a Nitze cystoscope was introduced. This was held in place by an assistant, while a suprapubic incision down to the bladder wall was made. The prevesical fat was well separated and the tissues well retracted by wide lateral retractors so as to give a good exposure of the bladder wall. The growth was then inspected through the cystoscope, the right hand holding the cystoscope; with the left, a needle was pressed on the fundus of the bladder, and the dimpling caused thereby was readily seen through the cystoscope. The needle was carried first to the left of the growth at a sufficient distance to give a margin of healthy bladder wall, it was then plunged into the bladder, being held in place by an assistant. The same procedure was carried out at the right of the growth and at the lower border. An attempt to place a needle above would have penetrated the parietal peritoneum, as this was involved in the growth. A sharp knife was now carried to the outer side of the three needles placed around the growth, the portion of the bladder wall to be removed being clamped at its cut edge as soon as the incision was started. The bladder wall containing the growth was lifted up by the clamp and held

by an assistant. The fluid left in the bladder was removed by a large syringe through the suprapubic wound to prevent its entrance into the peritoneal cavity. The incision in the bladder wall was then carried upwards into the peritoneal cavity and a portion of parietal peritoneum covering the growth was removed. The bladder and peritoneal wounds were then closed by two rows of sutures, a suprapubic drain being left in the bladder.

As far as I am able to learn, this method of attacking these growths has not been tried before. As I have stated, the operation is only applicable to growths in the fundus and lateral walls, but even when the growth is near the base it may be possible to get one or two points to guide us in the incision so as to prevent the traumatism to the growth by handling. I believe it is better to use sutures to fix the points of incision in preference to the needles I employed, as there is a slight leakage of fluid around the needles that lets the bladder wall relax and makes the introduction of the last needle difficult. On the other hand, a threaded needle can be seen with the cystoscope when it enters the bladder, and the location of the suture when in place can be readily noted if slight tension on it be made, so as to cause a stretching outward of the bladder wall at the point of suture. This tension also prevents leakage of fluid and facilitates the introduction of the other suture by preventing the slight collapsing of the bladder wall.

The patient on whom this operation was performed has made a good recovery and is apparently in good health. Of course it is too early to express any opinion as to the ultimate result in this case, but we do know that the tumor was removed without the slightest traumatism to the growth—not even the necrotic tissue present was disturbed.

INTRAPERITONEAL CYSTOTOMY.

BY CHAUNCEY E. TENNANT, M.D.,

OF DENVER, COL.

SURGICAL progress has always been subservient to tradition. This is as it should be, for only by careful consideration of past experience has it been possible to maintain surgical procedure on a safe and sound basis. It is this same tradition which is, no doubt, responsible for the present hesitancy in attacking the urinary bladder through the peritoneal cavity.

The possibilities and advantages of this route were successfully worked out and recommended by Harrington in 1893.[1] Since this admirable report, little or nothing appears in the surgical literature regarding this method of cystotomy, until an article by Charles H. Mayo in the July number of ANNALS OF SURGERY, 1908, entitled "Transperitoneal Removal of Tumors of the Bladder." Following this, two more contributions have been made to American literature regarding the method and technic, and report of cases. These are by Scudder and Davis, in the ANNALS OF SURGERY, vol xlviii, December, 1908, and E. S. Judd, in the *Journal A. M. A.*, vol. liii, December 25, 1909.

Long before Harrington pointed out the possibility of successful transperitoneal cystotomy, it was known that a normal urine was practically sterile.[2] It was also a well-known fact that punctures and accidental injuries to the ureters and bladder, occurring during operations, readily healed when properly repaired. In the face of all this, the persistent effort to avoid the intraperitoneal invasion of the bladder can only be attributed to a certain close adherence to time-honored traditions.

Why these should have retarded the development of urinary surgery more than other fields is difficult to explain, for the suprapubic and perineal muscle splitting operations, which have always been the recognized course of procedure,

are attended with a high mortality, and sometimes the permanent discomfort of a urinary fistula.

While it has long been recognized that urinary infiltration into the muscle planes produced early and profound absorptive symptoms, and even fatal toxæmias, it has also been known that the peritoneal cavity better tolerated this same urine. But in spite of all this, there has been a persistent choice of the route through the muscle planes to the bladder, neglecting the rapid healing, tolerant, and effectual peritoneal route.

Harrington, in his first report, said: "Intraperitoneal cystotomy may be performed for tumors of the bladder, for enlarged prostate, for disease of the ureters, for cases of large stone in the bladder, and for sacculated stone; there are advantages in the operation which, certainly at times, render it preferable to suprapubic cystotomy."

Watson in a comprehensive report, "The Operative Treatment of Tumors of the Bladder," [3] which covers records of 643 cases, says: "That 28.6 per cent. of benign and 46 per cent. of carcinomatous growths of the bladder have been surgical failures."

This is, of course, by the use of the muscle splitting suprapubic and perineal routes. In this same report Watson also shows that by the suprapubic route papillomata have been removed with 20 per cent. mortality, carcinoma with 28 per cent., and sarcoma 63 per cent., early recurrence following in both the benign and malignant forms in over 20 per cent. of the cases.

This high mortality is no doubt partially due to the urinary absorption through the severed muscle planes; also to the ineffectual means of reaching the tumor. The frequent recurrence is no doubt due to the incomplete removal of the mass and its adjacent tissue.

Dr. Charles Mayo in his report on "Transperitoneal Removal of Tumors of the Bladder" in the July ANNALS OF SURGERY, 1908, says:

"We have not been satisfied with the ordinary suprapubic incision in operating upon large tumors of the bladder."

According to Judd,[4] 90 per cent. of the tumors of the bladder begin in the base, consequently with the suprapubic and perineal incisions, it is impossible to secure good exposure or do a radical operation, and he further adds: "after closing the suprapubic incision in the bladder, we (the Mayos) have occasionally had the wound open and the urine drain for some time through this opening, *but in no instance has there been leakage from the incision through the peritoneal surface, which is no doubt owing to the firmer and more rapid healing of the peritoneum.*"

Statistical and clinical observation therefore indicate that intraperitoneal cystotomy should be more frequently the method of choice, and often it is the only method which can give any reasonable promise of permanent relief.

The more recent literature reports the successful use of the transperitoneal route for vesical tumors, especially where thorough inspection or removal of the bladder wall is deemed necessary. The mortality from this work appears to be decidedly less than with the muscle splitting operation, to say nothing of the security that comes with the knowledge of immediate bladder closure, and the comfort of the patient and nurses, while it also affords the best possible visual and operative access to all parts of the bladder.

Contrary to what one might naturally expect, the free opening of the bladder into the peritoneal cavity is not attended with a copious and annoying overflow of urine into the operative field. Somewhere in the recent literature I have seen the statement made that when an anæsthetized patient is placed in the Trendelenburg position (which is necessary in the transperitoneal cystotomy), there is practically little or no urine secreted, and this has seemed to be true in the cases I have operated by this method.

While I do not mean to advocate transperitoneal cystotomy in any but selected cases, I am sure that more successful results in bladder work may be accomplished, with considerably less mortality and much greater comfort to the patient, by the intraperitoneal route.

The method of operation as first recommended by Harrington, and later endorsed by Charles Mayo, Scudder, and Judd, is practically the same. The patient is placed in the Trendelenburg position, and a long median incision is made from the umbilicus to the symphysis pubis. The muscle planes, through which the incision has been made, and the abdominal viscera are packed out of the way, and the superior external angles of the bladder picked up and brought forward. An incision is made in the superior and posterior surface, the urine mopped out, and the incision continued down the posterior surface as far as deemed necessary. Two anchoring sutures may then be introduced through the bladder wall to spread the borders of the incision, when a full view of the inside of the bladder is obtained. Tumors may then be outlined, their relation and extent determined, and radical operations done for their removal.

Large sections of the bladder wall may be excised and the ureters transplanted with apparently no greater mortality than occurs in the ordinary ineffectual suprapubic operations.

Most authors recommend chromicized catgut through-and-through Connell suture, in closing the bladder, this to be followed by a peritoneal reinforcement with a linen Cushing suture.

I have used this method, and also plain catgut throughout, and now prefer the latter because of its certain and early absorption. Chromicized catgut may be more certain of holding the parts together, although I have found the knot (which should be made inside the bladder) discharge through the urethra five days after the operation.

A catheter may then be introduced into the bladder for continuous drainage, although some claim this is not necessary. I have been disposed to use the catheter for the first week following an intraperitoneal cystotomy. One certainly feels more secure with this safety-valve in place, and it offers but little added inconvenience to the patient, with no increased danger.

There is no need of testing the bladder for leakage, for if

the through-and-through sutures are well placed, close together, and the peritoneal covering well overlapped, it is certain to be water-tight under normal pressure.

The parietal peritoneum is then closed as usual, and the muscle sheaths united as in any other abdominal operation, excepting, however, in the writer's experience, the introduction of a small drainage tube down to the peritoneum for the first forty-eight hours. This procedure will save a possible postoperative abscess in the muscle planes, which is prone to occur where bacteriuria is present. If one has been careful to protect the edges of the abdominal incision, and feels absolutely certain there has been no infection, this last step may not be necessary, although it is advisable, as it affords escape for any urine left in the incision after the operation.

In two recent cases which I shall briefly report, I learned that it was possible to perform an intraperitoneal cystotomy in the presence of a very marked cystitis, although I do not wish to be understood as recommending this procedure without some very good reason for so doing. Both of these cases had a cloudy alkaline urine with pus, colon bacillus, and other pyogenic micro-organisms, but after careful consideration, it seemed best to use the transperitoneal route. Both cases were operated, the bladder immediately closed, and successful results secured, sparing both the patients and myself the annoyance and apprehension of a urinary fistula.

Case I.—Mr. P., age fifty-five, had hæmaturia for the past year, first at irregular intervals, then free and constant, with urinary obstruction due to large blood-clots. Patient lost considerably in weight; also much sleep, owing to frequent nocturnal micturition. Digital examination of the bladder through the rectum disclosed a horned-shape mass extending upwards and into the bladder from the upper border of the prostate gland. This tumor, although hard, seemed to involve the muscular coat. It was very difficult to use the cystoscope, owing to the great amount of bleeding, which frequent washing would not eliminate. However, a fair view was obtained of the upper surface of the mass, a deep ulcer appearing at the very apex.

The urine contained pus and blood, with a specific gravity of 1020, acid reaction, and a marked bacteriuria—colon bacillus and staphylococcus.

Removal by the transperitoneal method, following the technic as above described, was effected. A thorough removal of a hard indurated mass was accomplished, together with the prostate and a considerable portion of the mucous membrane. The bladder and abdominal incisions were completely closed, a catheter inserted in the urethra, and the bladder washed out once daily for the first week. There was no rise in temperature, no infection, and perfect repair, patient being discharged in two weeks.

CASE II.—Mr. W, age twenty-one. After fall on perineum one year ago, developed frequent urination with dysuria. More recently has had frequent chills and temperature, loss of weight and sleep, and is compelled to wear a rubber urinal both night and day. Examination with the finger in the rectum discloses a large mass about the right prostatic lobe, which is extremely tender. The urine is strongly alkaline, cloudy, foul odor, full of pus, and loaded with colon bacilli and diplococci. Sounds failed to disclose anything suggesting stone. While the use of the cystoscope provoked much tenesmus, in spite of the local anæsthetic which had been used, a little perseverance brought the lower end of the bladder into full view, when all question as to the diagnosis was put at rest by the sight of a large irregular white mass, covered with slimy mucus, and apparently partially encysted in the bladder wall. About this mass, as far as could be seen, the bladder was thick, œdematous, and suggestive of some other hidden lesion. Operation being at once accepted, I decided to undertake the transperitoneal method because of the appearance of the bladder wall and the embedded stone.

After making the abdominal incision, I discovered a chronic catarrhal appendix and removed it. Then packing everything well away from the bladder site, I made a long incision on its superior and posterior surface, delivered the stone weighing 26.5 grammes, examined the bladder walls and the urethral outlet, closed the bladder, introduced a soft rubber urethral catheter and washed out the bladder once daily.

A rise of temperature on the third day gave warning of a subcutaneous stitch abscess, which necessitated the removal

of several of the retaining sutures and drainage down to the peritoneum. The infection readily yielded to this treatment, and the abdominal incision promptly closed. The catheter was removed the seventh day, and the patient was out of bed with good bladder function on the fourteenth day.

While these are the only two cases which I have operated by this method, neither of them suffered with troublesome urinary fistulas nor had a complication because of opening a septic bladder. I report them, not to encourage the intraperitoneal cystotomy in every bladder lesion, but to show that it is possible to use this method even in the face of marked bacteriuria.

BIBLIOGRAPHY.

[1] Harrington: ANNALS OF SURGERY, October, 1893.
[2] Howitz: *Ibid.*, xlii, 857.
[3] Watson: ANNALS OF SURGERY, xlii, 807.
[4] E. S. Judd: Journal A. M. A., liii, 2147.

A CHART TO AID IN THE TREATMENT OF CYSTITIS BY DISTENTIONS OF THE BLADDER.

BY HOWARD A. KELLY, M.D.,

OF BALTIMORE, MD.

I DO not think we yet fully appreciate the value of appealing whenever it is possible to the eye as well as to the ear in our medical work and teaching. In instructing students and in demonstrating methods of operating in our text-books, the appeal to the eye by illustrations is now used with a fair degree of liberality, but there are other fields than these almost untried.

I have recently devised and am now using a chart such as shown in Fig. 1, as a valuable adjuvant in the treatment of cases of cystitis, and it is because I believe that some such ocular demonstration of the progress from week to week ought to be used in every case, that I here offer this simple but serviceable suggestion in the hope of extending its field of usefulness.

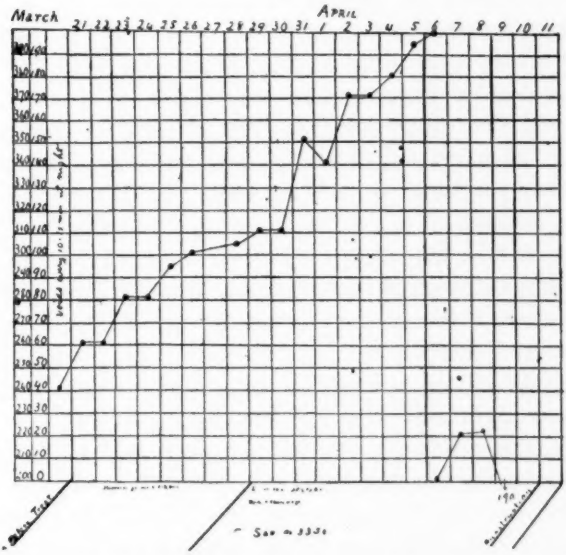
My patient was a married woman, thirty-seven years old. She had had no pregnancies in eight years of her married life. Her general health was good, and the entire complaint was lodged in the bladder, which began about six years ago to trouble her with sticking, knife-like pains in the lower abdomen, which became worse on exertion. Three or four years ago she had a frank attack of cystitis, when she passed a great deal of blood. The added pains associated with this attack have been pretty constant since that time, although there have been occasional remissions. She has often been compelled to void her urine 15 or 20 times a day as well as incessantly at night. She was so worn-out and nervous from her sufferings that she could not even endure an ordinary gently executed cystoscopic examination, so I gave her an anæsthetic and then examined the bladder at leisure and very thoroughly through my aero-cystoscope.

At the examination I found an injected area of pronounced cystitis with disappearance of the vesical vessels occupying the left lateral wall of the bladder and a part of the vertex. The rest of the bladder was normal and there was no disease at the base or abnormality about the ureteral orifices.

Treatment was then begun with an intelligent idea as to just what the disease was, where it was located, and how extensive it was. This was valuable also as a basis for comparison in following up the results of treatment.

I followed four courses in treating her: 1. Rest, not absolute

FIG. 1.



but relative. She was required to take things very easy and to lie about especially after the treatments. 2. Medication, there was but little medicine given by the mouth. 3. Local therapy, which constituted the sheet anchor in the treatment and to which she owes her improvement almost exclusively.

This consisted in distending the bladder to a maximum at first with a warm boric acid solution, followed at the end of the irrigation and distention by the instillation of a solution of nitrate of silver (1:1500).

At the suggestion of Dr. C. F. Burnam, my associate, I later used a carbolic acid solution (½ pc.) for the distentions, on

account of the sedative action of the drug as well as its value in sterilizing the surfaces with which it came into contact.

After the treatment was well under way, I conceived the idea that it would be a great help to the patient as well as to me if a large graduated chart like a temperature chart were made and hung on the wall, for the purpose of showing at a glance just what progress had been made from the first, what the actual status was at any given time, and what was expected for the future, that is to say, how great was the distance still remaining to the goal.

Such a chart serves both doctors and nurses as an excellent basis of appeal to the patient to do her best, and is a moral stimulus in moments of depression. She will not then be so likely to worry over little diurnal variations with the written record of decided improvement before her.

One can also determine the effect of psychic or of physical causes on the toleration of the bladder as well as the beneficial effect of any particular drug being used. In this special case my goal is a content of 500 c.c. (one pint). Starting out with an intolerant bladder tolerating only 40 c.c. (a little over an ounce), we have gone steadily up to over ten times the amount in seven weeks; no bad record for a case of years' standing. With this measured and charted improvement has gone a like improvement in all the symptoms. She used to void from 10 to 15 times at night, now it is but once or not at all.

On reaching the top of the chart one may begin again at the bottom using the left-hand column of figures with 200 on the lowest line and ascending to 400. When she runs again to the top I will write 400 to the left of the 200 column and carry the enumeration up to 500 or 600, where we will stop.

To effect this improvement I have given her 36 irrigations and 140 distentions. That is to say the bladder is irrigated every day if there is no reason to the contrary, and at each irrigation it is distended several times to a maximum.

In addition to the encouragement such a chart gives patient, nurse, and doctor, it is a great time saver and saves reading over the daily records to see what has been effected.

The individual squares in the figure are 1.5 cm. each way. I would make the chart long enough to hold from 30 to 50

treatments, and count each square equal to 10 c.c. of distention. Checker paper or chart paper can be bought for a few cents a sheet in larger or smaller squares suitable to hang on the wall or to file away with the history. A fine paper is Webb's co-ordinate draughting paper, which comes retail at 5 and 10 cents a sheet, less in quantity.

IS THE SAC OF A FEMORAL HERNIA OF CONGENITAL ORIGIN, OR ACQUIRED?

BY R. W. MURRAY, F.R.C.S.,

OF LIVERPOOL, ENG.

THERE is an ever-increasing tendency to regard the sac of an ordinary inguinal hernia as being of congenital origin and not acquired. The evidence that can be advanced in support of this view is very complete and convincing. In this communication I wish to direct attention to the etiology of femoral hernia, and will endeavor to answer satisfactorily the question, "Is the sac of a femoral hernia of congenital origin, or acquired?"

Though the sac of a femoral hernia is almost invariably found to occupy a position between the femoral vein and Gimbernat's ligament, cases have been recorded in which it has been seen in other situations. It has been found to descend in front of the femoral vessels, external to them, behind them, and even to pass through the fibres of Gimbernat's ligament.

Partridge, in the *Transactions of the Pathological Society* for 1847, relates a case of double femoral hernia in which both sacs were outside the femoral vessels. The left sac contained the sigmoid flexure; the cæcum and vermiform appendix were in the right. The accompanying drawing (Fig. 1), which is copied from Macready's "Treatise on Ruptures," shows three sacs—one in the usual position of a femoral hernia, a second peritoneal sac had traversed Gimbernat's ligament, and a third protruded over and to the outer side of the femoral artery.

These three peritoneal diverticula appear to me to have a very important bearing upon the etiology of femoral hernia. Macready tells us that: "The specimen was taken from the body of a woman between forty and fifty years of age, who had a rupture for several years. The hernia is in the usual situation. The abdominal entrance of both the other pouches

was narrower than the fundus, and both were surrounded by fat which had been partly removed by dissection."

How are we to explain the formation of these three peritoneal diverticula?

Surely one of two explanations must be true—either all three sacs had been acquired, or, as appears more probable, all three were of congenital origin. The fact that three diverticula were found in such close proximity is in favor of the developmental view; and this view as to their origin receives support from their shape, for it is distinctly stated that the abdominal entrance of both of these pouches was narrower than the fundus. Had these diverticula been produced by the bowel pushing the peritoneum in front of it, then the mouth of each sac would have been wide.

It might be argued that all three diverticula were acquired; that is to say that all three at one time were hernia sacs, but in two of them the neck and mouth of the sac had become narrowed, having undergone a natural cure. The objection to such an explanation is that clinical experience has never yet furnished a single instance in which an undoubtedly acquired hernia sac has undergone a spontaneous cure. The evidence, then, is strongly in favor of the congenital origin of two of these sacs, and as it is extremely unlikely that an acquired hernia sac would be formed between two existing peritoneal diverticula, we are compelled to believe that, in this instance at all events, the femoral sac was also pre-formed.

Though it is true that femoral hernia is seldom met with before adult life, still a number of cases has been recorded in which the hernia first appeared during childhood, and others in which it was present at birth or noticed during infancy.

In the ANNALS OF SURGERY for October, 1906, Wm. B. Coley, writing on the radical cure of femoral hernia, says: "Between the years 1891 and 1906 I performed 117 operations for femoral hernia in 105 patients. In 34 of these operations the patients were children between the ages of two and fourteen years. Nine were males and 18 females. In three operations the patients were under five years of age; in 15 operations the patients were from five to ten years of age; in 14 operations the patients were from ten to fourteen years of age."

In the article on hernia in Keating's "Cyclopædia of the Diseases of

Children," two cases of femoral hernia recorded by Edward Swasey are referred to. "A boy sixteen years of age presented himself at the hospital with unmistakable double femoral hernia. His mother said that when one year old he had a bad bronchial affection, with severe cough, and during this time the tumors appeared. They would disappear on lying down and increase in size on standing up, and especially upon coughing. The boy said the lumps had been present as long as he could remember."

Swasey also mentions another case of femoral hernia in a girl twelve years of age, whose mother positively asserted that the swelling had been present for four years.

Thomas Bryant, in the *Medical Times and Gazette* of 1862, vol. i, reports two cases of femoral hernia which occurred in girls, aged nine and twelve years respectively.

Edmund Owen, in his work on "Surgical Diseases of Children," mentions the case of a female child, six years of age, upon whom he operated for strangulated femoral hernia.

Ashby and Wright, in their work on "Diseases of Children," mention that Sabourin recorded a case of femoral hernia in a premature infant.

John Birkett, writing on hernia in Holmes's "System of Surgery," mentions a case of crural hernia he saw in a girl ten years old.

Lockwood, in his work, "Hernia, Hydrocele, and Varicocele," mentions two cases of femoral hernia upon which he operated, and which he considers might possibly have been congenital. "They occurred in boys aged twelve to fifteen, and had existed for years."

Macready, in referring to persons seen at the City of London Truss Society during the years 1888, 1889, and 1900, mentions 22 cases in which femoral hernia was met with in males under fifteen years of age, and 42 cases in which femoral hernia was noticed in females under fifteen years of age.

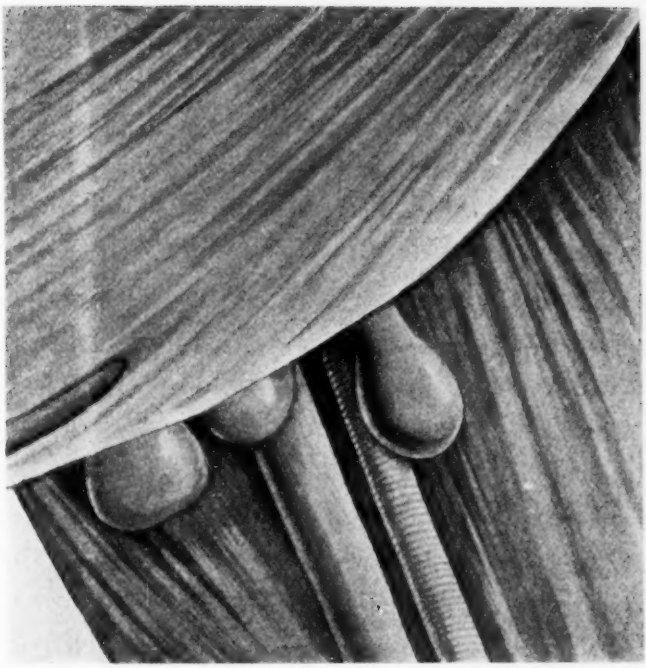
We have, then, 104 cases of femoral hernia occurring in children under fifteen years of age. In 52 of these cases the hernia first appeared between one and ten years of age, and in 9 instances it was first noticed before the children were five years old.

The relative frequency of femoral hernia in male and female children is about 1 to 2.

CASES OF FEMORAL HERNIA IN CHILDREN, ACCORDING TO AGE WHEN THE HERNIA WAS FIRST NOTICED.

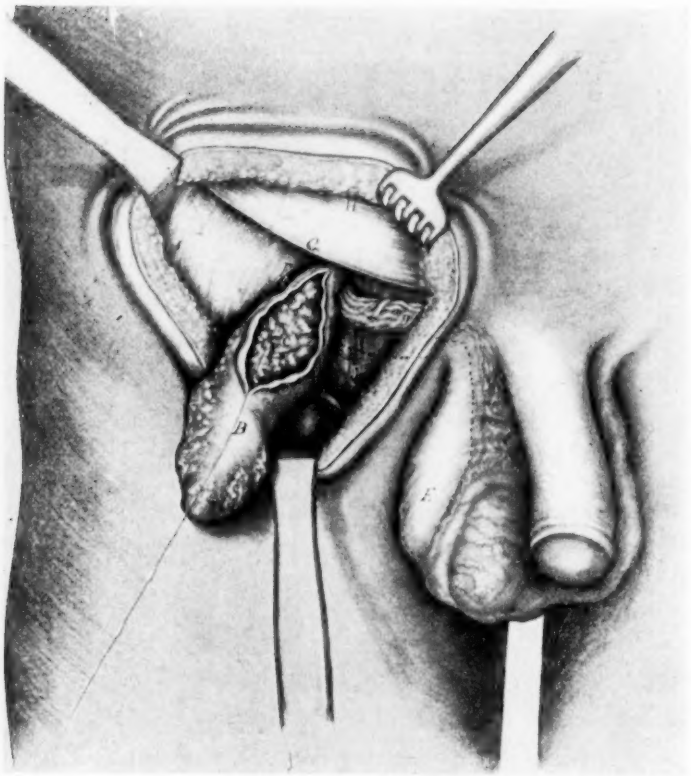
1–5	9
6–10	43
11–15	52
Total	104

FIG. 1.



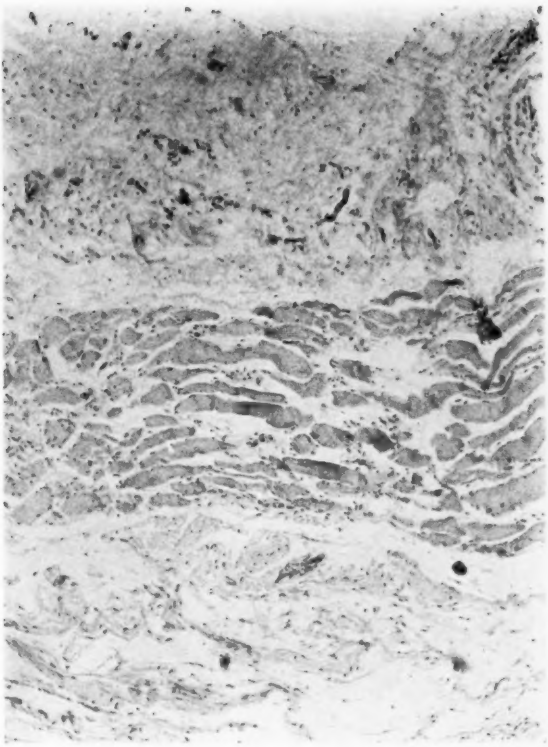
Three crural peritoneal diverticula. The central protrusion is the sac of a femoral hernia in the usual situation. A second sac had traversed Gimbernat's ligament, and a third had protruded over and to the outer side of the femoral artery.

FIG. 2.



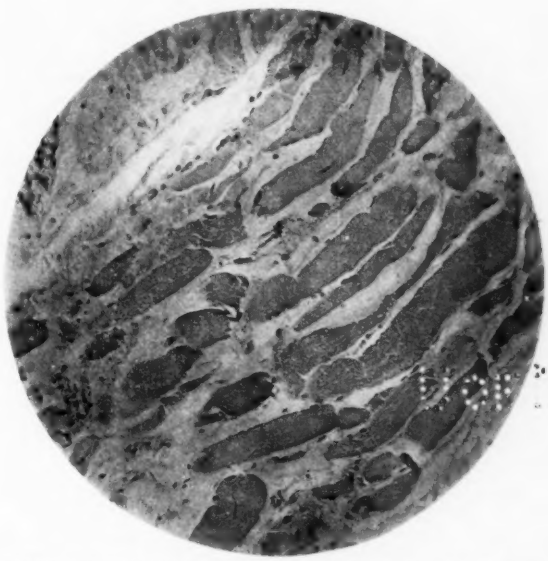
Cruroscrotal hernia. *A*, femoral ring; *B*, sac; *C*, omentum; *D*, cord; *E*, bed of the sac; *F*, falciform ligament; *G*, Poupart's ligament; *H*, aponeurosis external oblique muscle; *I*, Gimbernat's ligament; *J*, pectineus muscle.

FIG. 3.



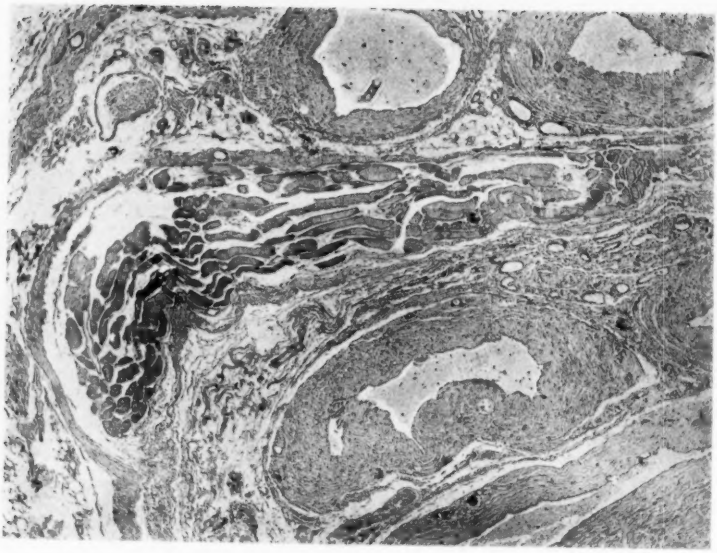
Muscular fibres from the fundus of a femoral hernia sac. (× 60 diam.)

FIG. 4.



Higher magnification (× 200) of muscle fibres shown in Fig. 3.

FIG. 5.



Normal gubernacular fibres (× 38 diam.).

FIG. 6.

Higher magnification (× 1000 diam.) of muscle fibres shown in Fig. 5.

In accordance with orthodox teaching, all these 104 hernia sacs had been acquired; but considering the age of the patients, and remembering that in 9 instances the hernia first appeared between one and five years of age, it is surely far more probable that the bowel had descended into a pre-formed sac.

In the case recorded by Edmund Owen, where strangulation of a femoral hernia occurred in a child six years of age, the only possible explanation is that the bowel had suddenly entered a pre-formed sac.

Femoral hernia is so frequently met with that if its essential cause is the presence of a pre-formed sac, then we would expect to find small peritoneal diverticula occupying the crural region, altogether apart from hernia.

In 200 consecutive post-mortem examinations, kindly made for me by Dr. Nathan Raw at the Mill Road Infirmary, upon persons in whom during life there was no history or evidence of hernia, in 47 bodies 52 femoral diverticula were present. In 14 instances they were bilateral. They invariably occupied a position corresponding exactly to that of a femoral hernia, and in shape closely resembled the inguinal pouches, having a narrow mouth and lumen, which would make it appear more probable that they were produced by some force pulling the peritoneum outwards, rather than by a pushing force from within. The fact that in the 47 bodies more than one diverticulum was present in 16 instances strongly suggests a developmental origin for both the inguinal and femoral pouches, and this view is strengthened by one case (No. 9) in which a double inguinal and double femoral sac existed.

I would call attention to the fact that so many of the femoral sacs were bilateral, and that in another case (No. 45), a girl aged seven years, a femoral diverticulum was present on both sides of the body. These femoral pouches are either all of congenital origin or all have been acquired; no compromise can be accepted. If they are all of congenital origin, and occur with such frequency as the tables indicate, and are so often found in the position which the sac of a femoral hernia normally occupies, then why suppose the sac of a femoral hernia is ever acquired?

I would remind surgeons who hold to the orthodox teaching, that if their view be correct then these pouches must have been acquired by the bowel pushing the peritoneum in front of it. Consequently we are asked to believe that amongst 47 persons no less than 58 femoral herniæ must at one time have existed, and that quite unknown to the individuals concerned—a suggestion which, to say the least, is extremely improbable.

Number.	Sex.	Age.	Potential Hernia Sac.
1	Male.	48	Double inguinal and right femoral.
2	"	61	Double inguinal.
3	"	46	Left femoral.
4	"	57	Right femoral.
5	"	39	Right inguinal (contained omentum).
6	"	55	Left inguinal (contained omentum).
7	"	42	Left femoral.
8	"	29	Right femoral.
9	"	44	Double inguinal and double femoral.
10	"	30	Right and left femoral.
11	"	63	Right and left femoral.
12	"	62	Right femoral.
13	"	32	Left inguinal.
14	"	45	Right femoral.
15	"	60	Right femoral.
16	"	61	Right and left femoral.
17	"	44	Right femoral.
18	"	64	Right femoral.
19	"	33	Right and left femoral.
20	"	54	Right femoral.
21	"	22	Right and left inguinal.
22	"	63	Right femoral.
23	"	44	Right and left femoral (small opening).
24	"	64	Right and left femoral (small opening).
25	"	28	Right and left femoral.
26	"	31	Right femoral.
27	"	44	Left femoral (small opening).
28	"	24	Right femoral.
29	"	56	Right and left femoral and umbilical.
30	"	55	Left femoral.
31	Female.	40	Right femoral.
32	"	14	Right and left femoral.
33	"	62	Left femoral.
34	"	54	Right femoral.
35	"	33	Right femoral.
36	"	60	Right and left femoral.
37	"	47	Left femoral (contained omentum).
38	"	56	Umbilical (contained omentum).
39	"	30	Left femoral (small opening).
40	"	43	Right femoral.
41	"	30	Right femoral.
42	"	37	Left inguinal.
43	"	44	Right femoral.
44	"	62	Right femoral.
45	"	7	Right and left femoral (small opening).
46	"	68	Right femoral and left inguinal.
47	"	18	Left femoral.

Two hundred bodies examined: In 47 bodies 68 peritoneal diverticula were found; in 16 instances more than one diverticulum was present.

30 males..... { 1 umbilical.
11 inguinal (4 double).
34 femoral (11 double).

17 females..... { 2 umbilical.
2 inguinal.
18 femoral (3 double).

It is a well-known fact that femoral hernia occurs with far greater frequency in women than in men, and, granted that a femoral sac occurs with equal frequency in both sexes, I would suggest that a hernia is more likely to occur in women, mainly for two reasons: (1) because in females the lateral expansion of the pelvis which takes place about puberty would tend to widen the mouth of a peritoneal diverticulum in the femoral region; (2) on account of increased pelvic pressure during pregnancy.

This suggestion receives support from the fact that femoral hernia appears with greatest frequency between the ages of twenty-one and forty-five years, the child-bearing period.

That it is possible, owing to some developmental irregularity, for a peritoneal diverticulum to occupy the crural canal, is clearly demonstrated by the accompanying drawing (Fig. 2), which illustrates an article in the ANNALS OF SURGERY for January, 1909, by Alexander Hugh Fergusson, of Chicago. The patient had suffered from a hernia in his right groin for 27 years. "He dated his rupture to a time when he was eighteen years of age, and was pitching hay on a farm. An extra effort was made with the pitchfork to heave hay, when suddenly he felt something give way in his right groin, and at once a tumor mass appeared in the scrotum."

In the following case, taken from the *Epitome* of the *British Medical Journal* for October 5, 1907, there can be little doubt, from the family history and the operative findings, as to the congenital origin of the hernia.

C. Provera[1] describes the case of a woman of twenty-four who came up for operation with a right crural hernia of a year's standing. Her brother had a right inguinal hernia, and one of her three sisters had bilateral hernia. The patient's tumor was the size of a walnut, painless excepting at the time of the menstrual flow, and reduced itself spontaneously when she lay down. When the sac was found, it had in its outer part a pink, rounded cord, the size of a goose's quill, looped. Light traction on the inner side of the sac brought part of the bladder into view, just at the point where the ureter, here reddened and dilated, entered it. The sac itself contained a little piece of omentum. The operation was performed

[1] Gorn d. R. Accad. di Med., Turin, 1907, 131.

in the usual way, and the patient made a straightforward recovery; at no time did she have any renal, ureteral, or vesical symptoms. Provera gives and discusses the literature of the subject.

I have not the least doubt that if the literature of the subject were carefully reviewed, a large number of cases would be found in which a femoral hernia had first appeared during infancy or childhood, but these mentioned are amply sufficient for the purpose. The earlier in life a hernia appears, the greater the probability of its being due to a developmental defect.

Clinical evidence, then, is strongly in favor of the belief that in a number of cases the sac of a femoral hernia is pre-formed, and is, therefore, the essential cause of the hernia.

The results obtained after operating for the cure of femoral hernia favor the view that the primary cause of the hernia is the presence of the sac; for if the sac were acquired owing to weakness of the abdominal wall, recurrence of the hernia after operation should very frequently take place, as for anatomical reasons it is extremely difficult to strengthen the abdominal wall at this point. Yet we know that most satisfactory results have been obtained after complete removal of the sac alone, without any attempt being made to reinforce the abdominal wall at the site of the hernia.

If, then, in some cases a pre-formed sac does determine the occurrence of a femoral hernia, and in many persons a peritoneal diverticulum persists throughout life, but is so small that the bowel has never entered it, it is surely rational to believe that in all cases and at all periods of life the occurrence of a femoral hernia is due to the fact that a potential hernia sac occupies the crural canal.

Granted the presence of a diverticulum, the descent of the bowel would depend, as in the inguinal or any other region, upon the size of the mouth of the sac. If the sac is a relatively large one, then the hernia may appear during infancy or childhood; if, as is more usually the case, the sac is at first small, then the bowel is not able to enter it, until with the growth of the individual it has attained a certain size

It is generally admitted that the gubernaculum, a fibromuscular mass, is in some way responsible, not only for the descent of the testicle into the scrotum, but also for the descent of the processus vaginalis, which reaches the bottom of the scrotum in advance of the testicle.

About the sixth month of fetal life the gubernaculum extends from the lumbar region through the inguinal canal, and has its chief attachment at the bottom of the scrotum; but bands also pass to the groin and to the root of the penis; others end in the peritoneum.

These additional bands are normally slender, but occasionally are sufficiently developed to influence the direction of the testicle, which may then be found in the perineum, at the root of the penis, or in the crural canal (Lockwood).

Whether it is by muscular action or by cicatricial contractions that the gubernaculum assists in the descent of the testicle and of the processus vaginalis, is still a disputed point, but that it does play a very important part in these changes is rendered probable by the nature of its structure, and by the fact that a remnant of gubernaculum can always be found in the adult, behind the epididymis and the testicle.

In the case of the cruroscrotal hernia above referred to (Fig. 2), it is, I take it, fair to assume that the abnormal descent of the testicle and processus vaginalis was most probably due to the abnormal attachment and development of the crural termination of the gubernaculum.

The evidence that we have, then, justifies us in assuming: 1. That the chief gubernacular band is attached to the bottom of the scrotum, and is responsible for the formation of the processus vaginalis, and for the descent of the testicle. 2. When the testicle together with a process of peritoneum is found to occupy the crural canal, it is probably due to an excessive development of a normally slender gubernacular band.

It is then reasonable to believe that a crural gubernacular attachment, developed in excess of the normal, may, without producing an abnormal descent of the testicle, drag upon the peritoneum sufficiently to make a dimple in the crural

region, which, with the growth of the individual, will develop into a potential hernia sac.

The surprising frequency with which crural peritoneal diverticula were found in the bodies examined at Mill Road Infirmary may thus be explained.

The shape of these diverticula and their narrow lumen strongly suggested that they were produced by some force pulling, rather than pushing, the peritoneum outwards.

If the sac of a femoral hernia is formed originally in this way, then some atrophied gubernacular fibres should be found at the fundus of the sac. At the same time it must be remembered that in any case the fibres will be scanty.

A few weeks after I had written the above remarks I secured, in the post-mortem room, from the body of a man sixty-one years of age, the sac of a femoral hernia. I sent the sac to the Clinical Research Association in London, asking that the fundus might be carefully examined for gubernacular fibres. This was done, and on November 30, 1909, I was delighted to receive the following report, together with a microscopic slide: "Sections made longitudinally of the fundus of this hernial sac certainly show small bundles of striated muscle. They can easily be picked out by their characteristic appearance, nuclei, striated sheath, etc." A photomicrograph of the slide is reproduced in Figs. 3 and 4.

So far as I am aware, this is the first time muscular fibres have been demonstrated at the fundus of a femoral hernia sac, but that is only because it is probably the first time they have been looked for there. It is, I hope, reasonable to infer that these muscular fibres are the remains of the gubernaculum, and further that as the scrotal band of these fibres influences in some way the descent of a peritoneal diverticulum into the scrotum, so a crural attachment of gubernacular fibres may in some way determine the formation of a peritoneal diverticulum in the femoral region.

Some of my friends to whom I showed this slide expressed a doubt as to these muscular bundles being gubernacular fibres, chiefly on account of their striation. For my own part, I

failed to see how the presence of muscular fibres at the fundus of a femoral sac could possibly be anything else than the remains of the gubernaculum. However, in order to clear up this point, I had the microscopic section, which is reproduced in Figs. 5 and 6, made for me by the Clinical Research Association. It was obtained from an adult, after making a series of sections of the structures immediately behind the epididymis. It represents normal gubernacular fibres in the mesorchium, and the striation of these fibres is seen distinctly.

One would expect striation to be more pronounced in the scrotal band of gubernacular fibres than in the crural, perineal, or any other band, owing to the gubernaculum blending with the internal oblique and transversalis muscles in its descent to the scrotum.

I trust it may be my good fortune to have an opportunity of examining an obturator and a sciatic hernia sac, for I feel confident that, if looked for, muscular fibres will be found at the fundus of both these sacs.

The discovery of gubernacular fibres at the fundus of a femoral sac is, to my mind, very strong evidence indeed of the congenital origin of hernia in this region.

I have not yet had the opportunity of searching for muscular fibres at the fundus of a femoral hernia sac in a woman, but feel confident of finding them there. In the female a structure corresponding with the gubernaculum is responsible for the descent of a peritoneal diverticulum into the inguinal canal, and I believe that in both sexes a crural band of these fibres is responsible for the occasional formation of a peritoneal diverticulum in the femoral region.

I have already explained why femoral hernia is met with more frequently in women than in men, and in conclusion would submit that clinical experience, operative experience, and also evidence obtained from the post-mortem room and from the pathological laboratory are strongly in favor of the view that the sac of a femoral hernia is of congenital origin and not acquired.

SILVER WIRE AND LINEN THREAD FOR THE CURE OF HERNIA.

BY JOSEPH WIENER, M.D.,

OF NEW YORK,

Adjunct Attending Surgeon, Mt. Sinai Hospital.

In a former paper[1] the writer drew attention to this "somewhat neglected field of reparative surgery." To the seven cases reported in 1906 he has been able to add many others. The great satisfaction he has received from these cases and the permanency of the results attained have induced him to make a detailed report.

It is just ten years since our attention was first called to the subject of wire filigree almost simultaneously by Witzel and Goepel. Witzel did not use a ready-made filigree. He first partly closed the hernial opening with a few silver sutures, and then covered over the opening still remaining with numerous thin silver wires passed in every direction. This method was good, but rather slow. To Goepel belongs the credit of having first made use of the ready-made filigree. He reported eleven cases of ventral and umbilical, and seven cases of inguinal hernia with sixteen cures. In the other two cases he removed the filigree on account of the formation of a hæmatoma. We now know that this is unnecessary, as the wound will heal even if a hæmatoma develops. Moreover, there may even be some wound infection with subsequent sinus formation, and yet the silver wire or the filigree need not be removed. It need hardly be said that hæmatoma formation is no more likely to result with silver wire than with catgut. Careful hæmostasis and a firm compression dressing will prevent it.

We make use of silver wire in two forms. The one consists of a suture made of fine strands of wire in the shape

[1] The Use of Silver Wire for the Cure of Large Herniæ, ANNALS OF SURGERY, April, 1906.

of a cable. This was devised by Dr. Howard Lilienthal, and we can recommend it most heartily. It is made in various sizes, is much stronger than the ordinary silver wire, much more pliable, and can be tied into a knot with ease. Where the hernial opening is very large we use a filigree made of thin silver wire. We use a filigree somewhat on the order of that described by Bartlett, of St. Louis, in volume xxxviii, ANNALS OF SURGERY, 1903.

To quote from the former paper of the writer:

"The filigree I have employed has been that devised by Bartlett, and I have followed his directions closely. He advised the use of the ready-made filigree, made of thin wire, not heavier than gauge No. 30. The heavier wire is not resilient enough, and does not adapt itself so well to the tissues, and in consequence it is apt to cause irritation. Another advantage of the filigree over silver-wire sutures is the fact that it can be introduced very quickly. Furthermore, and this is a matter of great importance, the filigree can be placed between the tissues at a much greater distance from the edges of the opening than would be possible in passing a needle. It should widely overlap the hernial opening on all sides. No sutures are required to hold the filigree in place. If any one doubts the correctness of this statement, he has but to remember what happens when we inadvertently leave a piece of gauze in a wound. How quickly are the meshes of the gauze filled with granulation tissue, which anchors it in place so firmly that it can only be removed with the greatest difficulty. The same process goes on with the filigree. In a few weeks it is so firmly anchored in place that great force is required for its removal. This has been proven experimentally on animals. Another advantage in not suturing the filigree in place is the fact that it can then better adapt itself to the surrounding tissues, and there is less likelihood of its causing irritation. If properly made and properly inserted it should cause no discomfort whatever; the patient should not be aware of its presence. . . . As is well known, scars in the abdominal wall generally spread most in a lateral direction. The filigree, which can be readily made by any one, depends for its efficacy upon the fact that all but one of the wires run across the long axis of the hernial opening. The filigree should overlap the opening by at least an inch all around. It is so made that each cross wire ends in a loop, thus obviating sharp ends. If sutures of silver wire are used, they should not attempt to approximate the tissues (a frequent cause of failure). It is always better to depend on two layers of silver; either two filigrees in two different planes, or one filigree and one reinforcing layer of silver sutures, provided the superficial muscles or fascia can be approximated without any tension. In general it is well to place the filigree as deeply as possible; sometimes it is not necessary to open the peritoneal cavity. But the filigree must extend well beyond the hernial opening on all sides. This necessitates dissecting up the muscles all

around before introducing the filigree. Then the superficial plane of muscles or fascia may be united with silver-wire sutures, or a second filigree is introduced. Or a filigree can be made by a running suture of wire that does not approximate the tissues, but simply fills the gap. By following this method we have a double guard against recurrence of the hernia."

The filigree should be so pliable that it will bend with respiratory movements. It will then accurately mould itself during the healing process to the locality in which it is placed, and it will not cause any local irritation, which would necessitate its removal. The meshes should not be too close and the wire should not be too heavy. It is surprising how well such a flimsy looking filigree, when it has healed into the tissues, will prevent the recurrence of a hernia. The writer has several cases that have been doing severe physical labor for four and five years, in perfect comfort, and without any relapse. If such cases are examined a few months after operation it is impossible to feel any part of the filigree, so effectually has it become imbedded in the tissues.

The indications for the use of silver wire will vary with the individual operator, and some surgeons never use it. A recent English writer, McGavin, uses it in old people with large hernial openings, in people who habitually throw an extra strain on their abdominal muscles, in patients with poorly developed abdominal muscles, and finally in recurrent herniæ. To these groups of cases we would add one other, cases in which the muscles and fascia cannot be approximated without tension.

In recurrent cases, if the first operation was properly done and the wound healed by primary union, then a second Bassini operation done on the same tissues is not likely to be permanently successful. Where Poupart's ligament or the oblique muscles, or both, are poorly developed, it is not fair to expect any better result the second time than the first, if the ordinary suture material is employed. We have been using silver cable sutures in these cases with good results. We have also used a filigree in a few very large inguinal herniæ. Even if we succeed in dragging the attenuated oblique muscle

over to the poorly developed Poupart's ligament, is it not asking too much to expect some tissues to permanently prevent the reformation of a hernia? Even using the rectus muscle or its sheath is in many cases unsatisfactory. And yet we have seen surgeons do a third, or even a fourth Bassini operation (with catgut) for recurrences. Each time they went through the form of a typical operation, using the same poorly developed tissues that nature had unmistakenly declared to be unfit for the work at hand.

Why there should be a sentimental objection to putting a so-called foreign body into the wound, in the shape of silver sutures or a filigree, we have never been able to understand. And why some men prefer to do most extensive plastic operations for the cure of herniæ, which often fail to give a permanent cure however pretty they may look on the table, in place of the simple and reliable procedure of using a filigree, is also hard to understand. For after all we are not dealing with a matter of sentiment, nor is our object the doing of a pretty piece of work. Our problem is rather the plain and prosy one of curing a large or a recurrent hernia, where the anatomical conditions are such that autoplastic operations do not give much chance for radical cure. The usual objection we hear is that the filigree will irritate and will have to be removed. The answer to this, in the light of our experience, is very simple. If the proper wire is used in the first place, if the filigree is properly made in the second place, and if it is properly introduced in the third place, it will very seldom be necessary to remove a filigree. Personally we have only once been compelled to remove one, where it was introduced as a ready-made filigree. In no case have we had to remove a filigree when made of running sutures of wire. In some of our cases there has been some superficial infection of the wound, especially in fat patients, due to trauma of the fat. In such cases a sinus has remained for a longer or shorter period, but except in the one case referred to above we have never removed the filigree or the wire sutures, and the wounds have all healed. In the majority of cases, with

proper materials properly employed, our wounds have healed as rapidly as in cases in which we have used absorbable sutures. Where the filigree is made of running sutures, the silver cable wire devised by Dr. Lilienthal will be found much more satisfactory than ordinary silver wire. Where there is much gaping of the tissues, no attempt is made to approximate them. The gap is filled by running sutures back and forth in figure-of-eight style. In some cases a filigree made beforehand may be used. This may be placed between the peritoneum and transversalis, or the filigree may be used in a more superficial plane.

CASE I.—Israel M., fifty-three years old, was first admitted to Mount Sinai Hospital in November, 1902. There had been a gradually increasing right inguinal hernia for three years. The hernia had been irreducible for one year, and there had been several attacks of abdominal pain. The hernia, on admission, was 58 cm. in circumference and was only partly reducible. On opening the sac, Dr. Lilienthal found it to contain small intestine, cæcum, and ascending colon, the latter firmly adherent to the sac. The adherent appendix was removed. The sac was so firmly adherent to the cord and testis that their detachment was impracticable. Testis cord and part of the sac were removed; the intestines were replaced, and the neck of the sac closed with chromic gut. No sutures were used; the wound was packed with gauze and a compression bandage was applied. During convalescence there was some sloughing of the fascia and of the deeper tissues. A large exudate which formed in the scrotum required incision. The man left the hospital after two and a half months, wearing a truss. Six months later he returned to the hospital. The hernia could no longer be retained by a truss; it was only partly reducible and prevented the man from earning a living. The dangers of a radical operation were explained to him, but he begged to have it done. On August, 1903, I excised the scar tissue and opened the sac. The many coils of small intestine could not be reduced until the patient had been placed in extreme Trendelenburg's position. Even then it was very difficult. The sac was freed from adhesions and tied off. The inguinal canal was so large that it was impossible to close it with sutures. The ring was narrowed by a purse-string suture of silver wire. A filigree was now placed over the inguinal canal, and the superficial fascia and skin brought together with sutures. Following the operation we attempted to keep the foot of the bed elevated, but unfortunately this caused nausea, retching, cyanosis, and dyspnœa. Although the bowels moved daily, the man was always restless and uncomfortable. Three days after operation he began to vomit, restlessness and cyanosis increased, and six days after operation he died. Examination showed that the filigree was in place and that there had been no infection whatever. Death was caused by the fact that

the abdominal cavity could not accommodate itself to the large amount of intestines that had been in the sac.

CASE II.—Mrs. Ray M., thirty-four years old, was referred to me by her physician. In October, 1900, she had been operated on by the late Dr. Bull, who removed diseased adnexa through a median incision. A hernia developed in the scar five months after operation. A few months later there was a sudden attack of pain in the right side of the abdomen, accompanied by vomiting and fever. This attack was followed by similar ones. The hernia increased in size, it became painful, and the truss no longer retained it. Operation, October 27, 1904. The sac contained a large mass of omentum. The omentum was replaced, the appendix removed, the sac dissected out and tied off. The peritoneum was closed with a running catgut suture. The posterior sheaths of the recti and the muscles themselves were approximated with chromic sutures. It was not possible to close the opening in the fascia entirely. With silver-wire sutures passed from side to side to form a filigree, the gap was filled in. The skin was closed with silk. The wound healed by primary union. Five and a half years have elapsed since this operation was performed, and the patient has been perfectly comfortable and has had no relapse.

CASE III.—William K., thirty years old, admitted January 6, 1905. There had been an oblique right inguinal hernia for three years, and a similar hernia on the left side for one year. Operation on the right side by Dr. Lilienthal. For the Bassini sutures twisted silver-wire sutures were used. The operation on the left side was performed by the writer. There was such a wide separation of the deeper structures that it was impossible to approximate them. The gap was bridged over by a running silver suture, returning the suture so as to make a sort of figure-of-eight filigree. The superficial fascia and skin were sutured separately. Both wounds healed by primary union.

CASE IV.—Louis R., thirty-seven years old, admitted May 5, 1905. Two months before admission the man, while getting off a moving car, was thrown against a steel column. He sustained a fracture of the humerus, dislocation of the clavicle and three upper ribs, and a large ventral hernia in the left iliac fossa. On May 9 I performed a partial excision of the clavicle and three upper ribs. Eight days later I exposed the ventral hernia through a three-inch transverse incision. The peritoneum was not opened. A silver filigree two by three and a half inches was placed between peritoneum and transversalis. The external oblique was approximated with a running silver-wire suture and the skin with silk. The wound healed by primary union. The man has not suffered any discomfort from the wire.

CASE V.—Tony M., twenty-four years old, admitted July 10, 1905. In 1901 there had been an operation for appendicitis. A year later a hernia developed in the scar; it had always been reducible until two weeks before admission. At that time the hernia suddenly became larger and vomiting set in. The hernia was five inches wide and three inches long. On the surface of the mass there were several small ulcers. Operation, July 12, 1905. Hernioplasty with resection of gut, for large ventral hernia

with gangrene of gut. The hernia consisted of several loops of firmly adherent small intestine. One loop had perforated the skin and formed the large ulcer on the surface of the skin. On account of its poor condition six inches of this loop, together with the adherent skin, were resected. End-to-end anastomosis with the Connell suture was done. The circulation in the adjacent loop of gut was not very good, and two pieces of rubber dam were placed around the suture line. As the patient's condition was poor, and as the operation had already consumed considerable time, it was decided to use silver wire to close the abdominal wall. The hernial ring was freed and through-and-through silver-wire sutures were passed from side to side. In this way the greater part of the wound was closed. The drains emerged from the centre of the ring. The skin was closed with silk. For two weeks there was a slight fecal discharge from the wound. Thereafter the wound healed steadily, and the patient left the hospital with a healed wound on August 16, 1905. Since then the girl has been doing arduous housework, including lifting of heavy weights, without any pain or discomfort.

CASE VI.—Golde B., thirty years old, admitted October 3, 1905. The patient had an umbilical hernia of five years' standing. Five days before admission the hernia had for the first time become irreducible. The bowels could not be moved and vomiting set in. The hernia was the size of an orange, tense, and tender. Operation on October 3, 1905, immediately after admission. The sac contained omentum and one loop of small intestine. The gut was replaced and the omentum resected. Three sutures of silver wire almost completely obliterated the diastasis at the neck of the sac. A few catgut sutures approximated the superficial tissues. A small cigarette drain was introduced and the skin closed with silk. The wound was entirely healed in sixteen days. It would not have been possible to have brought the fascia together in any other manner. Three months later, after a severe attack of bronchitis, the patient developed a small hernia just below the umbilicus. Had a filigree been put in besides the wire sutures, this would probably not have occurred.

CASE VII.—Mary M., twenty-seven years old, admitted October 3, 1905. Two weeks before admission the woman noticed a mass in the right hypochondrium and epigastrium. The mass was hard, smooth, adherent to the abdominal wall, and measured about three by five inches. The tumor was excised through a vertical incision in the right hypochondrium. It involved the right rectus and the adjacent portions of the oblique muscles; it was also adherent to the parietal peritoneum. Portions of the oblique muscles, the rectus, including both its sheaths, and the adherent peritoneum were removed, together with the tumor. It was only with difficulty that the peritoneum could be brought together with catgut sutures. A filigree was then placed in the depth of the wound, and a second filigree made by passing running sutures of silver wire through the oblique muscles. A drain was placed at either angle and the skin approximated with zinc oxide plaster. The pathologist, Dr. Mandlebaum, reported the tumor to be an inflamed fibroma. Recovery was rapid and uneventful.

The above seven cases were reported by the writer in his previous paper referred to before. The cases reported below have been operated upon by the writer since 1905. They form but a small proportion of the total number of hernia cases which he has operated on by other methods during this time. But, with increasing experience, silver wire is being used by him in a larger proportion of the cases with the most gratifying results.

We wish to state here that during the past eighteen months we have entirely discarded chromic catgut in hernia cases. We were led to this step by seeing several hernias, done by competent surgeons, that recurred within six weeks after the time of operation. All these cases had been simple cases of inguinal hernia which had healed without any infection. After giving the matter some thought, we came to the conclusion that this unfortunate condition could be explained in only two ways: either the catgut knots opened as the result of coughing or vomiting, or the catgut was absorbed too soon and allowed a recurrence. The writer had also frequently noticed at operations that some strands of chromic gut were very brittle, and sutures sometimes had to be passed several times before a good strand was found.

All these facts induced the writer to discard chromic gut in hernia cases. Where a patient's welfare and the success of an operation are to so great an extent dependent on the suture material, it has seemed to us that we should use the safest material we can find. Catgut, no matter how prepared, is not safe. But we have a material which is easily prepared, which is always sterile, which is never quickly absorbed, and with which the knots never open spontaneously. We refer to Pagenstecher linen. We have used this in over 100 operations, most of them herniotomies. Among these cases we have as yet seen no recurrence. We use No. 2 or No. 3 size, and seldom have it tear. It does not irritate the tissues, almost all the cases have healed by primary union, and they have stayed healed. We were warned when we began this work that in many cases we would be compelled to remove knots. Fortunately this has not happened. Our

wounds have healed just as satisfactorily as when we used catgut. In only a single case were we compelled to remove any sutures. That was in the case of a physician, who was very fat, on whom we did a difficult hernioplasty. He developed a fat necrosis (undoubtedly due to trauma at the operation), a sinus remained until we removed the linen sutures under local anæsthesia six weeks after operation. This case is also free from recurrence. In not another case were we compelled to remove any of the linen sutures after operation. The more we use the material, the more pleased we become with it. It is certainly a satisfaction at the time of operation to know that we are using sutures that will not be absorbed too soon. If we have a recurrence after the use of linen sutures, we can say with certainty that the material is not to blame, and many recurrences after the use of chromic gut can, we firmly believe, be correctly attributed to the catgut. So that in all simple hernia cases, whether inguinal, femoral, or ventral, we use linen sutures. In all recurrent cases we use silver wire. The linen is wound on glass spools, boiled for fifteen or twenty minutes, and preserved in 95 per cent. alcohol.

We have not reported in detail any of the cases in which linen sutures were employed, as they ran the same course as cases where catgut was used. All the case reports in this paper deal with cases in which silver wire, in one form or another, was employed.

CASE VIII.—Israel F., sixty-two years old, admitted February 26, 1906. There had been a right inguinal hernia for ten years and a left inguinal hernia for two years. The man had worn a truss for many years. Both herniæ were reducible. Operation February 27, 1906, under local anæsthesia. Right side: The intestine in the sac was reduced and the sac resected. Both the internal oblique and Poupart's ligament were very atrophic and relaxed and there was a wide hiatus between them. The upper angle was closed with chromic gut, but it was impossible to close the lower part of the wound, on account of the wide separation. Accordingly, a running suture of silver wire was introduced to form a filigree. No tension was made on this suture and no attempt was made to drag the tissues together.

Catgut was used for the aponeurosis and silk for the skin. Left side: Similar anatomical conditions were found and a similar operation was performed. Both wounds healed by primary union, and the man went home on March 16.

CASE IX.—George E., fifty-five years old, admitted October 4, 1906. The man had had a left inguinal hernia for many years. During the past two years it had been only partly reducible and had been increasing in size. The right ring admitted one and a half fingers, and there was an impulse on coughing. On the left side there was a hernia as large as a child's head, containing many loops of gut, which could be returned only with difficulty. Operation, October 5, 1906. The sac was opened and the loops of small intestine reduced. The transverse colon and the sigmoid were adherent to the sac and were reduced only after the adhesions were divided. Extensive dissection was required to free the sac, which was tied off with a chromic gut suture. It was not possible to suture the conjoined tendon to Poupart's ligament on account of the wide diastasis. They were approximated by two running sutures of silver-wire cable sutures. To strengthen the wire it was braided with a piece of chromic gut (a good device). The fascia was sutured with chromic gut, the skin with silk. A small tube drain was placed in the scrotum. The wound healed by primary union, and the patient left the hospital on October 21.

CASE X.—Sarah K., thirty-three years old, admitted January 9, 1907. Two years before admission the patient had had both ovaries removed. One year before that an umbilical hernia had appeared, which slowly increased in size in spite of a truss. Four months before admission a hernia showed itself in the median cœliotomy scar; this became gradually larger. On examination, we found a small umbilical hernia containing adherent omentum. Below the umbilicus there was a scar from a median wound which had evidently been drained at its lower angle. Just to the right of this scar there was a reducible hernia as large as a fist. January 11, 1907, hernioplasty for umbilical and ventral hernia. A median incision was made, starting above the umbilicus and extending to within two inches of the pubis. Adherent omentum at the umbilicus was resected and the umbilicus excised. The fascia and muscle surrounding the ventral hernia were then dissected free, disclosing a hiatus of four inches with very thin fascia. The peritoneum was closed with catgut. The

deep fascia and muscle were together approximated with chromic gut, the muscle thereby being placed under considerable tension. A silver-wire filigree was placed over this suture layer, and a running suture of silver cable wire was passed through the edges of the superficial fascia in the form of a filigree, as approximation was not possible. The deep layer of the fat was closed with a few catgut sutures. A split rubber tube was placed at either angle of the wound and the rest of the wound strapped with zinc oxide plaster. Time of operation was fifty-five minutes. The patient developed a postoperative pneumonia, which caused her death four days after operation.

REMARKS.—To-day I would not make any attempt to suture muscle and fascia in a case of this kind. After closing the peritoneum I would place a filigree between the peritoneum and the deep fascia, and a second filigree between the superficial fascia and the muscle. Such an operation could be done in half an hour and the danger of a pneumonia minimized. We believe that the deaths from pneumonia, following operations for umbilical hernia in fat patients, will be much fewer if less extensive dissections and shorter operations be undertaken.

CASE XI.—Abraham K., twenty-two years old, admitted June 26, 1907. The man had been operated on by another surgeon two years previously for a right inguinal hernia. The typical Bassini operation had been done, chromic gut sutures had been used, one suture having been passed above the cord. The wound had healed by primary union. We found a small reducible recurrent inguinal hernia on the right side. Operation June 28, 1907. The sac was excised and the cord freed; the recurrence was at the lower angle. Three silver-wire sutures were passed over the cord, uniting the muscle to Poupart's ligament. Two additional chromic gut sutures were passed above and below the silver sutures. The fascia was united with catgut, the skin with silk. On the left side a large ring was found and a considerable gap between the muscles and Poupart's ligament. These tissues were united over the cord with chromic sutures. Both wounds healed by primary union, and the man left the hospital July 11, 1907.

CASE XII.—Louis H., thirty years old, admitted July 5, 1907. The man had a congenital inguinal hernia on the right side, and a direct inguinal hernia on the left side. On the right side Ferguson's modification of the Bassini operation was done with chromic gut for the deep sutures. On the left side there was a direct hernia through the transversalis fascia. The upper half of the wound could be closed with chromic sutures, but below there would have been too much tension. Accordingly two sutures of silver wire were passed in the form of a filigree. The aponeurosis was united with catgut, the skin with silk. The wounds healed by primary union, and the patient went home on July 22.

CASE XIII.—Israel M., forty-five years old, admitted July 11, 1907. The man had had a right inguinal hernia for six months. The right ring admitted two fingers, and there was a bulging on coughing. The left ring also admitted two fingers, but there was no impulse on coughing. Operation July 12, 1907. Right side: A small sac found and tied off. Poupart's ligament was very thin. Two chromic sutures were used at the upper angle and four silver-wire sutures below them. Catgut was used for the aponeurosis, silk for the skin. Left side: No sac was found. The cord was buried by six chromic sutures. The man was discharged after a normal convalescence on July 29.

REMARKS.—Where the ring on the side opposite to a hernia is large we habitually close the ring at the time of operation, as we have found that many of these cases return a year or two later with a hernia on the opposite side, if this precaution is not taken. This step takes but a very few minutes, and we readily get the consent of both hospital and private patients when we explain to them the dangers of a subsequent hernia on the opposite side.

CASE XIV.—George N., eighteen years old, admitted July 22, 1907. In February, 1907, the man had been operated on for an infantile inguinal hernia. Soon after leaving the hospital he had noticed a recurrence. The writer had performed the original operation, using six No. 2 chromic sutures. The wound had healed by primary union, the temperature never exceeding 100° F. He had been kept in bed 14 days and had been in the hospital 20 days. On examination we found a reducible hernia. Operation July 24, 1907. A large sac was found which was dissected

from the surrounding tissues. Poupart's ligament was in such poor condition that it was out of the question to use it for a radical cure, so the fascia lata was exposed. The internal oblique muscle was sutured to Poupart's ligament and to the fascia lata by a running silver-wire cable suture. The aponeurosis of the external oblique was closed with catgut, the skin with silk. Time of operation, 35 minutes. The wound healed by primary union, and the man was discharged on August 8.

CASE XV.—Philip P., forty-two years old, admitted December 30, 1907. The man had been operated on twice for a left inguinal hernia, the first time at the German Hospital in Philadelphia, in 1905, and the second time at Mt. Sinai Hospital in the following year. The man stated that three months after his second operation the hernia had again recurred. It had always been easily reducible, and he had not worn a truss. The external ring was one and a half inches in diameter, and the hernia descended to the upper part of the scrotum. Operation, January 3, 1906. The sac contained omentum which was resected. Both the oblique muscles and Poupart's ligament were very poorly developed. The sac was excised. The cord was buried by several silver-wire cable sutures, uniting internal oblique and Poupart's. Chromic gut was used for the fascia and silk for the skin. The wound healed by primary intention.

CASE XVI.—Samuel M., twenty-three years old, admitted January 14, 1908. The man had a left inguinal hernia of three months' standing. The sac, as well as the contained omentum, were resected. Both the conjoined tendon and Poupart's were so poorly developed that the deep chromic gut sutures were reinforced by three silver-wire sutures. The fascia was closed with catgut, the skin with silk. Recovery was uneventful and the patient went home on February 5.

CASE XVII.—Nathan B., fifty years old, admitted January 23, 1908. Eight weeks before admission a left inguinal hernia developed. Five years before, after lifting a heavy weight, a hernia developed on the right side. Operation, January 27, 1908. On the right side a large hernial sac was excised. Bassini sutures of chromic gut were used, plain catgut for the fascia, and silk for the skin. On the left side a sliding hernia was found. The muscles were poorly developed, and accordingly silver wire was used for the deeper sutures. Otherwise the operation was done as on the right side.

REMARKS.—To-day the writer would be afraid to trust to chromic sutures in a case like this. He would use linen sutures on the right side, and silver sutures on the left side.

CASE XVIII.—Max S., thirty years old, admitted February 8, 1908. Three weeks before admission a left inguinal hernia was noticed. The inguinal ring barely admitted the tip of the index finger. Overlying Poupart's and almost as long as it, there was a mass which increased in size on coughing and which gave an impulse. The abdominal muscles in this region were thin, and at times it seemed as if there was a protrusion through them. Operation, February 10, 1908. The omentum in the left hernial sac was resected. Poupart's, except near the pubes, was absent and was replaced by a thin layer of muscular fibres. The cord, which was poorly developed, was buried by several chromic sutures, uniting the muscle to the crural fascia at the outer part, and several silver-wire sutures were used to sew the muscle to the periosteum of the pubes and also to Gimbernat's ligament. Catgut was used for the fascia and silk for the skin. Recovery was uneventful.

CASE XIX.—Koppel R., forty years old, admitted February 27, 1908. The patient had been operated on at Mount Sinai Hospital by another surgeon three months before his readmission. At that time he had stated that he had had a double inguinal hernia of three years' standing. It had always been possible to retain the herniæ with a double truss. The typical Bassini operation had been done on one side, and the Ferguson modification on the other. Chromic gut had been used for the deep sutures, and both wounds had healed by primary union. The man returned to the hospital, stating that five or six weeks after the operation he noticed, on coughing, a small protrusion on the right side. On the left side he had the feeling as if something protruded on coughing. On examination both rings were found enlarged, the right more than the left, and a small protrusion was felt on both sides, more on the right. Operation, March 3, 1908. Right side: A large opening was found at the centre of Poupart's, readily admitting a finger. There were no muscular attachments to the inner four-fifths of Poupart's, only a small slip of internal oblique was attached to the outer fifth. Four silver-wire cable sutures were used to unite the internal oblique and transversalis to Poupart's, the last one passing through the periosteum of the

pubis. The fascia was united with chromic gut, the skin with silk. Left side: The internal oblique was attached to Poupart's only over its outer half. The inner half was entirely free from muscular attachment. No hernial sac was found. A similar procedure to that done on the right side was carried out. Both wounds healed by primary union.

REMARKS.—A double recurrence in six weeks in a case like this, in which both wounds had healed by primary union and in which the operation had been performed *lege artis*, means one of two things: either the chromic sutures were absorbed too soon, or the knots of the sutures opened as the result of coughing or vomiting. The writer did not do the first operation in this case, but he has seen several similar cases done by different surgeons, and he has had one similar case of his own:

Bernard W., forty-two years old, admitted April 29, 1908. Two months before his admission to the hospital the man had been operated on at another hospital in this city for a double inguinal hernia. Shortly after his return home a recurrence took place on the left side. The man refused another operation.

Such cases (and they are not so rare) are a most potent argument in favor of using linen sutures.

The case is reported as being another early or rather immediate recurrence after the use of chromic gut. There had been no wound infection in this case.

CASE XX.—Nathan W., twenty years old, admitted August 4, 1908. In November, 1907, the writer operated on this man for a bilateral hernia. On the right side he had found a large sac, and on the left side a small one. Chromic gut had been used for the deeper sutures. With the exception of a slight superficial stitch-hole infection, convalescence was normal, and the man had left the hospital with both wounds healed two weeks after operation. On readmission the patient stated that immediately after he returned home he had noticed a small protrusion, which gradually increased in size, in the region of the scar on the left side. A month before his readmission he noticed a swelling on the right side, which rapidly increased in size, gradually working its way

down into the scrotum. On examination we found both herniæ easily reducible. Both inguinal rings admitted three finger-tips. Operation, August 7, 1908. Right side: The contents of the sac were reduced except one loop of gut broadly adherent to the sac at its neck. This was dissected free and the sac resected. The poorly developed conjoined tendon was sutured to the equally poorly developed Poupart's by a running silver-wire suture. Catgut was used for the aponeurosis and silk for the skin. Left side: After reducing the hernial contents the sac was resected. The conjoined tendon was fairly well developed, but Poupart's was very thin. A running silver-wire suture united these two structures. Both wounds healed kindly.

REMARKS.—As in the cases reported above, the chromic gut was evidently at fault, as the recurrence on one side took place immediately after the return home of the patient. It is interesting to note that both this case and Case XVIII were operated on in November, 1907. At that time our chromic gut was evidently too rapidly absorbed and allowed such early recurrences. In Case XIX we have the additional features of poorly developed Poupart's ligaments on both sides and poorly developed muscle in addition on the right side. Had this case been sutured with silver wire in the first instance, a recurrence would probably not have taken place.

CASE XXI.—Rebecca G., fifty-four years old, admitted August 8, 1908. The patient had had a double inguinal hernia from childhood. She had been operated on at a Newark hospital in 1905. Four weeks later a recurrence took place on both sides, larger on the left side than on the right. The left hernia steadily increased in size, with occasional symptoms of mild obstruction. On examination we found a large reducible left inguinal hernia with a ring that admitted three fingers. On the right side the ring was equally large, but the hernia was smaller than on the opposite side. Operation, August 10, 1908. Left side: The sac was adherent. All the contained small intestines were reduced except one loop which was adherent by a broad band at the bottom of the sac. This band was divided and the loop returned. The sac was then excised. The conjoined tendon was poorly developed. Poupart's ligament was flabby and showed

no evidence of having been sutured at the previous operation. With six silver-wire sutures the fairly well-developed rectus muscle was sutured to Poupart's, each suture taking as much as possible of the conjoined tendon. In this way both conjoined tendon and rectus muscle were used to close the canal. The external oblique was closed with catgut, the skin with silk. The patient did not want to have any operation done on the opposite side.

REMARKS.—Here again we probably have to deal with a case in which the chromic gut was absorbed too soon or the knots opened, and the patient had a double recurrence in four weeks. The muscle had been in contact with Poupart's for so short a time that at our operation, done three years later, no evidence of its having been sutured could be found. Such cases of very early recurrence after the use of chromic gut are not so rare as we have been led to think. The writer has seen enough of them at the hands of various surgeons to strengthen his conviction that linen is a far better suture material in hernia cases than chromic gut. In a hundred cases of hernia in which linen was used for the deeper sutures, the writer has as yet not seen a single recurrence. He does not mean to say that recurrences will not occur after the use of linen, but he does mean to say most emphatically that they will occur less often than when chromic gut is used.

CASE XXII.—Barbara G., thirty-eight years old, admitted January 2, 1909. The patient had been operated on for double inguinal hernia by another surgeon in 1904. Five weeks after the operation, which was done with chromic gut, a recurrence took place on the right side. The hernia had always been reducible after its recurrence, until one week before the patient came to the hospital. At that time the hernia became painful and irreducible. The day before operation vomiting set in. We found an irreducible right inguinal hernia as large as a plum. Attempts at taxis were unsuccessful. Operation, January 2, 1909. The hernia was reduced under anæsthesia. The sac was resected. Poupart's ligament was very poorly developed. Five sutures of silver-wire cable were used to unite the conjoined tendon to Poupart's over the cord. The fascia was sutured with

chromic gut, the skin with silk. The patient left the hospital on January 20, after an uneventful convalescence.

REMARKS.—We have here another immediate recurrence after a herniotomy, done by another surgeon with chromic gut. It is true there was an additional complication in this case, in a poorly developed Poupart's. But do not most surgeons use chromic gut in cases of this kind, even where the muscles and the ligament are poorly developed? Are such cases not much more suitable for linen or silver sutures?

CASE XXIII.—Anna J., twenty-six years old, admitted June 6, 1909. The patient was the sister of a physician. She had been operated upon by Murphy, of Chicago, for appendicitis in 1897. A large ventral hernia, partly reducible, had developed in the scar. Operation, June 17, 1909. The old scar was excised and the peritoneum was found adherent to the skin. The hernial opening was three inches long and two inches wide. By dissection the rectus muscle was exposed on the inner side and the retracted fascia and muscle on the outer side near the anterior superior spine. The incision was about seven inches long. Adhesions between the uterus and the anterior abdominal wall were divided. Two inflammatory cysts were removed from the left iliac fossa. The right tube and ovary had been removed with the appendix. Adhesions between the uterus and bladder were broken up and a piece of chromicized Cargile membrane placed between these two organs. The peritoneum was closed with chromic gut. The muscle and fascial flaps were dissected back far enough on either side to admit placing two silver-wire filigrees, each three by five inches, between the peritoneum (which had been sutured) and the fascia. Muscle and fascia were now sutured over this filigree but not approximated, except at the two angles (where there was no tension) with silver-wire sutures. The skin was closed with silk. The wound healed by primary union, and the patient was able to leave the hospital in two weeks. As this was a private case, we were able to follow it carefully. In spite of the large amount of silver wire employed in this case, the patient suffered no discomfort therefrom. The wound has remained solidly healed. We doubt very much whether we could have obtained as satisfactory a permanent result with any other suture material.

CASE XXIV.—Pauline D., twenty-five years old, admitted

March 29, 1909. Nine months before admission, after a difficult labor, an umbilical hernia developed. The hernia was easily reducible, though it was gradually increasing in size. The patient had endocarditis and nephritis; there was marked dyspnœa on exertion and frequent œdema of the feet. Operation, March 31, 1909. The abdominal wall was remarkably thin. The small sac was resected after the contained omentum had been replaced. Owing to the condition of the patient's heart and kidneys, we decided to do a rapid operation and avoid extensive dissection. The thin musculo-aponeurotic layer was broadly overlapped by a running suture of silver wire. The skin was closed with silk. After a normal convalescence the patient left the hospital on April 19.

CASE XXV.—Dora E., fifty-four years old, admitted May 31, 1909. This was a private patient who had an umbilical hernia of many years' standing. The hernia has increased in size with each pregnancy. It had been irreducible for several years, and at times very painful. On examination we found an irreducible umbilical hernia the size of a man's fist. The whole surface of the hernia was inflamed, and at the most prominent part there was an ulceration probably due to rubbing of the clothing. Operation, June 1, 1909. The ulcerated area was cauterized with carbolic acid, followed by alcohol. Omentum was found adherent in several pockets. The omentum and the sac were resected. The peritoneum was closed with chromic gut, the fascia was overlapped from side to side with silver-wire sutures. A slit rubber tube was placed at either angle of the wound. There was primary union of the wound. The patient was discharged in fifteen days.

CASE XXVI.—Nathan B., sixty-five years old, admitted September 27, 1909. The patient had worn a truss for twenty-five years for a right inguinal hernia. He had recently noticed a slight swelling in the left groin. We found a large irreducible scrotal hernia on the right side, and a small reducible inguinal hernia on the left side. Operation, September 29, 1909. Herniorrhaphy for hernia of bladder. A large sac was found on the right side, and closely adherent to it the urinary bladder, which had prolapsed through the inguinal canal. The bladder was separated from the sac without injuring it. The sac was opened and its contents reduced. The sac was then excised and the bladder returned to its normal position. The muscles were very much

atrophied from the many years' use of the truss. Bassini sutures of silver wire were used, the cord being buried. To reinforce a weak area in the muscles, a silver-wire filigree, one by three inches, was inserted. The fascia was sutured with chromic gut, the skin with silk. A postoperative hæmatoma in the tunica vaginalis broke down and caused a profuse purulent discharge. The patient left the hospital on October 27 with a sinus that has persisted, although the discharge has become very scanty.

CASE XXVII.—Max R., twenty-two years old, admitted February 12, 1910. The patient had been operated on by another surgeon in 1905. The abstract of his history at that time was as follows: "Since 1898 the patient had had a reducible right inguinal hernia. The right ring admits two fingers, the left ring the tip of the index finger. Operation, March 16, 1905. A typical Bassini operation was done on the right side. On the left side no sac was found and the internal oblique was sewed to Poupart's. Chromic gut was used on both sides. The left side healed by primary union, the right side became infected." From the time the patient left the hospital until six months before his readmission he was well. He then noticed a bulging in the left inguinal region, which was easily reducible. We found a small hernia in the scar on the left side, the side that had healed by primary union. The right side, in which there had been some infection, showed no evidence of recurrence. Operation, February 10, 1910. A left inguinal hernia was found with the sac adherent to the cord. The sac was resected, and the conjoined tendon sewed over the cord to Poupart's with five silver-wire sutures. Convalescence was uneventful.

CASE XXVIII.—Abraham A., fifty-one years old, admitted February 14, 1910. Two years before admission a right inguinal hernia had developed. This had gradually increased in size until walking had become almost impossible. We found a right scrotal hernia, as large as a cocoanut, consisting largely of gut, which was easily reduced. The ring was large and admitted three fingers. On the left side there was an incomplete indirect hernia, with a marked impulse on coughing. Operation, February 16, 1910. Left side: The sac contained omentum and small and large intestine. The contents were reduced and the sac resected. To close the canal five silver-wire sutures were used, and in between these several sutures of linen. Right side: A similar operation was done. The sac was not so large, and only five

silver-wire sutures were used to unite the conjoined tendon and Poupart's. Both wounds healed by primary union and the patient went home on March 17.

CASE XXIX.—Louis G., four years old, admitted February 26, 1910. The child had a congenital left inguinal hernia and undescended testis. The testis could be felt in the lower part of the inguinal canal, and could be brought down into the scrotum. The hernia was as large as an egg; it was easily reduced. The mother stated that another child in the family had a double congenital inguinal hernia. Operation, February 28, 1910. A fairly large sac was found. Both the oblique muscles and Poupart's were very poorly developed. On this account six silver-wire sutures and three linen sutures were used to join the conjoined tendon to Poupart's. We followed our usual technic and left the cord lying posterior to the suture line. The child left the hospital with a healed wound on March 19.

Hernias form so large a proportion of our surgical cases, and yet it would almost seem as if we did not give them as much thought and study as they deserve. We seem to have fallen into a rut these past ten years and do our herniotomies by rule of thumb. Is it not time to call a halt on the promiscuous use of chromic gut in herniotomies? Have we not been worshipping a fetich too long? It is true that we had unsatisfactory results with silk sutures. The knots irritated and often had to be removed. But this is not true with Pagenstecher linen. We can report a hundred cases, and in only one did we have to remove any sutures; and that in a case of fat necrosis, where catgut sutures would probably also have had to be removed.

The startling number of immediate recurrences after the Bassini operation with chromic gut, in which the original operation was done by various surgeons (and once by the writer) reported above, are surely worthy of serious consideration. They cannot be argued away. It is idle for a surgeon to say that this does not happen to him. The various surgeons that did the original operations in the cases reported above know nothing about these relapses. These cases happened to fall under the writer's care. As they came in close succession, they made a marked impression on him, and have

been the cause of his change of technic, both in regard to original operations for hernia and also in recurrent cases.

We are convinced that our results are much improved. There will surely be less recurrences, both early and late, with linen sutures than with chromic gut or kangaroo tendon. And is it not to be expected that we will have much better results in recurrent cases if we use silver wire instead of catgut? There is a very pleasant feeling of security in doing an important herniotomy, to know that our linen knots (especially if three knots are made) will never open as the result of coughing or vomiting. With catgut we are never sure. The same thing applies to the early absorption of the knot. That is unknown with linen sutures and happens not so seldom with catgut, to the chagrin of the surgeon and the disgust of the patient.

As regards the recurrent cases, the writer is more and more convinced, with increasing experience, that some form of silver wire is, in many of the cases, a very desirable suture material. This is especially true of the cases in which either the muscle or Poupart's or both are poorly developed. We firmly believe that in such cases catgut is entirely out of place for the deep sutures. In some recurrent cases, where the tissues are well developed, linen will be very satisfactory, but in many of these recurrent cases, the best results will be obtained with silver wire.

We have no desire to be dogmatic, but, from what we have seen at the hands of other surgeons and from the cases reported above, we have in our hernia work come to the following conclusions:

1. Chromic catgut is an unreliable suture material.

2. Pagenstecher linen is an excellent suture material.

3. Silver wire, in some form, is a very desirable suture material in many recurrent cases; and at primary operations where the tissues are poorly developed

4. Immediate recurrence, in uninfected cases, is usually due to chromic gut.

5. We will have fewer recurrences if we entirely discard chromic gut sutures.

A PNEUMATIC TOURNIQUET.*

BY FRANK E. BUNTS, M.D.,
OF CLEVELAND, O.

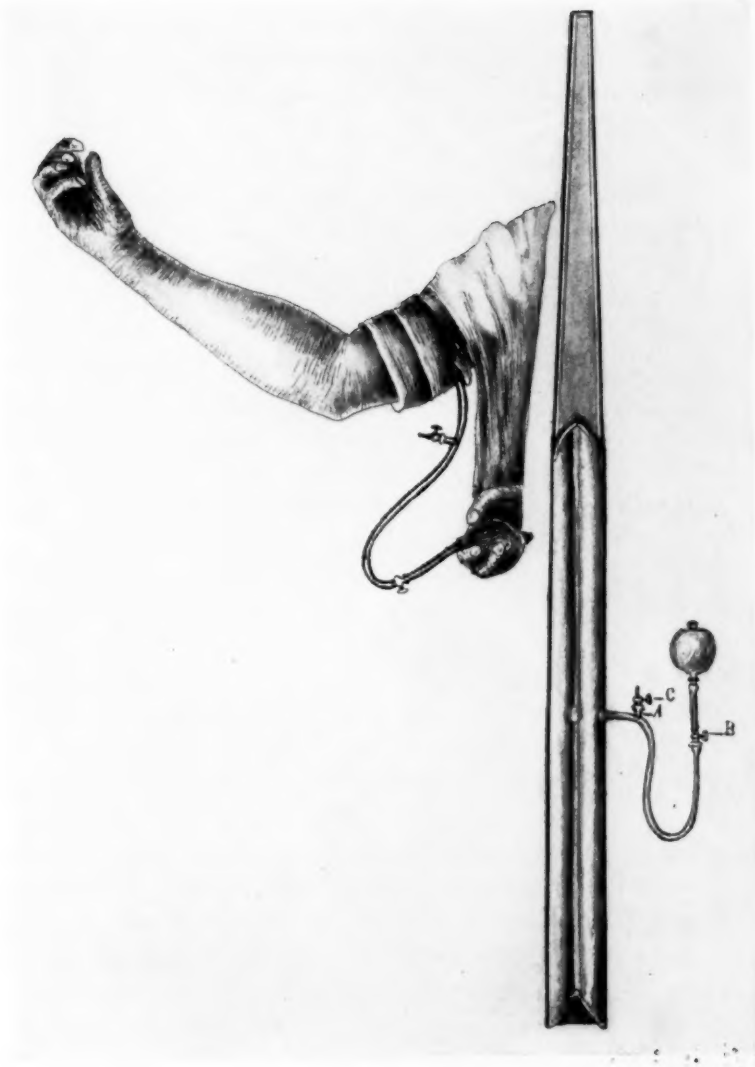
In "Ashhurst's International Encyclopedia of Surgery" may be found an interesting account of the introduction of the tourniquet, which I venture to reproduce, viz.:

> Next to the introduction of the ligature, the most important improvement in the operation of amputation was the invention of the tourniquet or "gripe-stick," as it was called by the English translator of Le Clerc. In its original form, this instrument, which was also known as the garrot or Spanish windlass, seems to have been devised about the same time (1674) by Morel, a French military surgeon, during the siege of Besançon, and by Young, of Plymouth, England, as described in his "Currus Triumphalis e terebintho," published in 1679. Morel's apparatus consisted of a thick compress, which was placed around the limb, and surrounded with a cord or small rope, under which were slipped two short sticks, by twisting which the cord was drawn very tight. Morel's tourniquet was improved by Le Dran and other surgeons by placing an additional pad immediately over the vessels and below the circular compress, by using only one stick for twisting the cord, and by placing beneath this a piece of paste-board—or, according to Garengeot, of horn or leather—so as to render the pressure on the skin less severe, and thus avoid the risk of sloughing, which sometimes followed the use of Morel's instrument. But the greatest improvement in the tourniquet was that made in 1718 by the illustrious J. L. Petit—le grand Petit, as he has been sometimes called to distinguish him from other less famous surgeons of the same name—and though, with its wooden plates and screw, we should think it but a rude contrivance, it was in all essential points the same instrument as the tourniquet employed at the present day.

Many other tourniquets have found their way into the armamentarium of the surgeon, such as Signoroni's, Lister's Cartes, Higgenbottom's, Tuffnell's, Skey's, and Esmarch's and their modifications. Some have had in view direct pressure upon the main artery of the limb but most have been, after all, but a slight improvement upon the garrot or Spanish

*Read in the Clinical and Pathological Section of the Cleveland Academy of Medicine, March 4, 1910.

FIG. 1.



The pneumatic tourniquet.

windlass. The one most commonly used is the Esmarch rubber band and chain or a simple rubber tube. These are certainly sufficient so far as controlling hemorrhage is concerned but are often so applied, either through ignorance, carelessness or perhaps unavoidably, as to cause very serious results, among which nerve palsy may particularly be mentioned. Thus when applied tightly above the elbow, musculospiral palsy may result and, if below the knee, peroneal nerve palsy sometimes follows.

In children particularly the need of some more suitable and more safely regulated pressure is manifest and, with this especially in view, I present for consideration a pneumatic tourniquet which, I think, will do away with some of the more obvious dangers of the older form of tourniquet.

In the *Medical News,* March 26, 1904, Dr. Harvey Cushing calls attention to a pneumatic tourniquet, which he had devised, based upon the well-known armlet of the Riva-Rocci blood-pressure apparatus and described as being a similar armlet though broader, of less distensible rubber and of such quality that it would stand boiling and, by connecting it with a bicycle pump of sufficient size, one or two quick strokes of the piston would fill it. This form of tourniquet has never become very popular, partly through lack of interest or information on the part of the profession, and partly because of the difficulty of keeping it from rolling when inflated and the necessity of a somewhat cumbersome apparatus (a bicycle pump) for its inflation.

I have devised an apparatus which is made of rubber and linen and consists virtually of two long rubber bags fastened together along their inner margins but connected at the middle by an opening through this fastening which permits the air to circulate simultaneously in both tubes when inflated. This obviates one of the greatest difficulties experienced in the construction of a practical pneumatic tourniquet. If it be made of a single rubber bag, the inflation will cause the superimposed turns of the tourniquet to roll off of each other and thus relieve the constriction. With the double tubes this cannot occur and it remains exactly where placed. The first one

constructed for me was made of pure rubber and enclosed in a linen bag to prevent its overdistention but, as it was somewhat inconvenient to remove it and replace it in the bag for cleansing or sterilizing purposes, I have had the present one made of much the same material as the familiar obstetrical pad, which is sufficiently elastic, very strong and durable and can be readily sterilized. It has a tapering end which, after the tourniquet is in place, is tucked under the inflatable part and becomes fixed as soon as pressure is applied. From the middle of one of the bags projects a rubber tube with an offshoot, *A*, two stop-cocks, *B* and *C*, which permit respectively inflation by means of an attached bulb, and gradual diminution or total abolition of pressure by opening and allowing the escape of the air. If done slowly, undoubtedly venous engorgement would take place, but the inflature may be rapidly accomplished by a few pressures upon the bulb, and if still greater precaution against congestion is needed, the limb may be elevated or a Martin bandage applied before compressing with the tourniquet.

It can be applied uninflated to the limb prior to its preparation for operation and then, when needed, the circulation can be shut off by compression of the bulb without any disarrangement of the preparations about the field of operation. If, for any reason during the operation, it be desired to restore the circulation or to see whether the vessels have been secured, the air may be slowly allowed to escape by the anæsthetist or nurse by opening the stop-cock *C*, and controlled instantly by the re-inflation of the tourniquet, without having to readjust it. The advantage of this is apparent to any one who has been obliged to re-apply the ordinary tourniquet which has for any reason been removed when dressing the wound or at the close of an operation. The necessary disarrangement of towels and sheets and the pulling and jerking of the limb during this procedure are only too well known.

There are many practical applications of this tourniquet that suggest themselves, but it seems to me that one of the most beneficial would be its adoption by those engaged in the

ambulance service or wherever it may require application by those not skilled in the use of tourniquets in general or not familiar with their dangers. Where the amount of visible hemorrhage is the only indication, certainly there could be no excuse for the viciously tight tourniquets and Spanish windlasses that we only too commonly see applied. A smaller one could be readily made which might be used for operations upon the scalp or skull, and it might find a most useful application in replacing some of the more cumbersome forms of armlets used in blood-pressure apparatus.

THE CONTROL OF HEMORRHAGE BY MEANS OF FORCEPS-TOURNIQUET IN MAJOR AMPUTATIONS.

BY J. LYNN THOMAS, C.B., F.R.C.S.,

OF CARDIFF, ENGLAND,

Surgeon to the Cardiff Infirmary.

It was in an article published in *The Lancet,* 23d of April, 1898, that I first suggested the method of controlling hemorrhage at the hip-joint by means of a pair of forceps similar in general form to those of Doyen's stomach-clamp. Since that time I have performed all my major amputations after the same fashion, and have neither used the Esmarch's, nor any other form of tourniquet, nor have I availed myself of the services of a trained assistant to control hemorrhage in cases where great authorities like Lister, Macewen, Syme, and others have recommended them.

The pattern of forceps-tourniquet which I now use and find most convenient is illustrated in Fig. 1.

The blades of the forceps are 6½ inches long. For the purpose of description, I call the blade which is passed into the tissues, the *internal* blade; this is passed behind the blood-vessels and has a blunt point and is smooth and rounded in order to facilitate its passage through the tissues; at the same time to guard against the possibility of doing damage to blood-vessels or nerves against which it may impinge during its forcible passage.

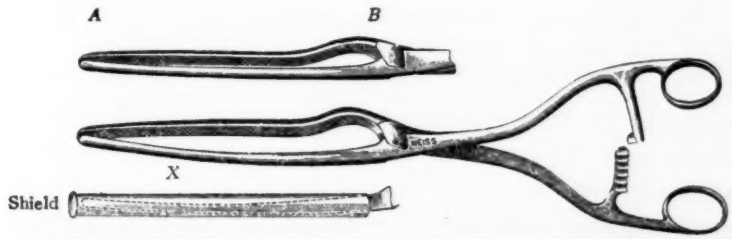
I have found the ordinary Doyen clamp to be positively dangerous for the purpose, on account of the point and the edge of a blade being often as keen as that of a knife edge. The *external* blade (*i.e.,* the one in contact with skin) is rough and serrated in order to prevent it slipping over the surface of the skin. The *shoulder* is made on this blade in order to avoid compression of the skin and underlying tissues when

the forceps is clamped on a muscular or fat limb, and also to prevent interference with the compression force of the far end of the forceps.

The principle of the method is that of simultaneous parallel compression of the blood-vessels (artery and vein) between the blades of the forceps; one blade (internal) being placed behind the blood-vessels to be controlled, and the other blade (external) being in contact with the skin.

In Fig. 2 is represented a transverse section through the hip-joint at a point where the internal blade of the forceps has been passed behind the blood-vessels and its external blade in contact with the skin.

FIG. 1.



A–B, 6½ inches (six and a half inches). *X*, smallest diameter of internal blade 14b measured by Cicero Smith's micrometer. Shield for carrying antiseptic jelly for the internal blade during military operations.

I will describe the method as originally employed at the hip-joint. A small stab puncture was made immediately below the anterior superior spine of the ilium, and through this the *internal* probe-pointed blade was pushed forcibly towards the neck of the femur, parallel with Poupart's ligament, and driven home as far as it would go. The limb was then elevated vertically for a couple of minutes in order to exsanguinate it, then the forceps was clamped; this action effectually and simultaneously compressed the common femoral artery and vein. After the anterior flap was made and turned up, the gaping blood-vessels were clamped by hæmostatic forceps and afterwards the forceps-tourniquet was released and withdrawn and was then passed behind the neck of the femur in order to control the blood-vessels in the posterior flap.

By this method the loss of blood during amputations of

the hip-joint has become practically negligible, and in quantity is not more than is always lost during amputation by any of the other so-called bloodless methods.

In 1904 I recorded a series of amputations which I had at that time performed successfully by this method of control of the main blood-vessels, and they included *three* at the hip, *five* interscapulothoracic, *seven* through the thigh, and others.

I then claimed that the mortality in amputations following this method of controlling hemorrhage was not more than that after any other method ever suggested. Since that time I have performed similar operations successfully, and in one case I have successfully removed the ilium in addition to the removal of the whole lower extremity.

The ages of my patients have ranged from infants to that of an old lady of eighty-four.

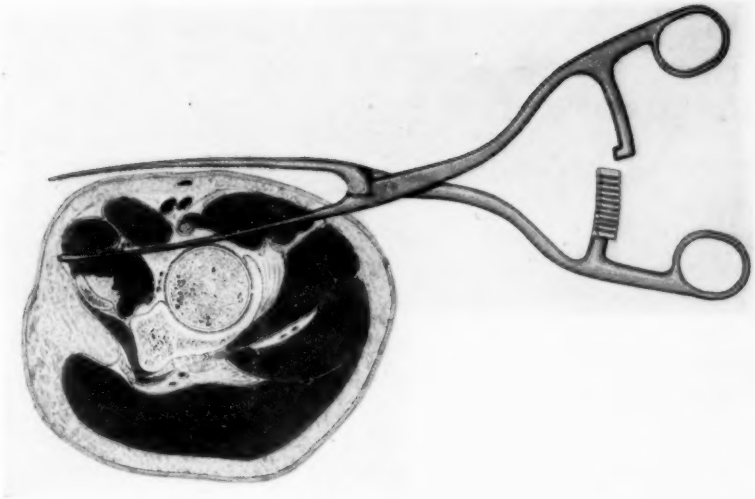
The method is simple, effective, reliable, and requires no assistant; the forceps-tourniquet is easily sterilized with the ordinary instruments, and during the operation it is entirely under the sole control of the operator.

It is not my intention to discuss the value of other methods of controlling hemorrhage, which are so well known to your readers, but I would invite my American confrères to give this method a trial, as I feel that it can be adopted without anxiety in the scrupulous requirements of modern aseptic or antiseptic surgery.

I believe that Dr. Charles Mayo was the first to use this method of controlling hemorrhage in the United States.

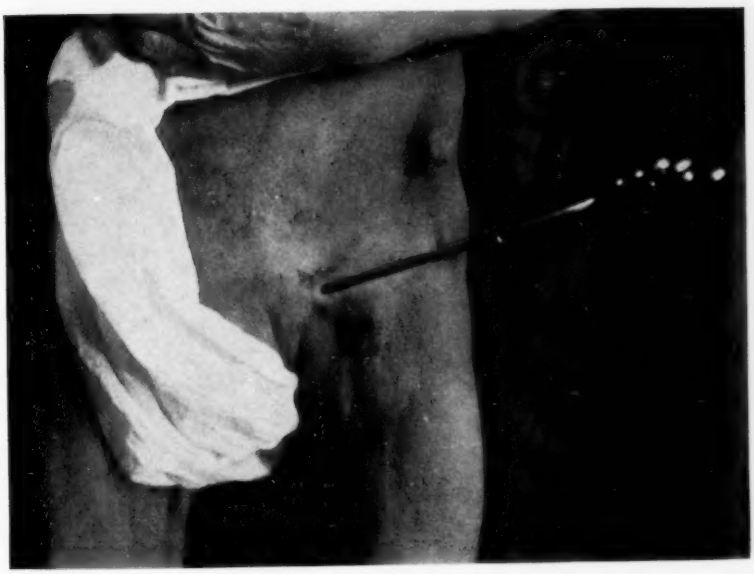
Note.—Since the above was written I am glad to find that Dr. Binnie in the second volume of his "Operative Surgery" refers to the method. Professor Kocher in Europe and Jacobson in England, and Thompson and Wiley in Scotland have already included in their well-known works my method amongst the recognized ones.

FIG. 2.



Section of thigh through hip-joint showing method of controlling femoral vessels by forceps-tourniquet.

FIG. 3.



Forceps-tourniquet applied to left femoral vessels.

FIGURES ABOUT FRACTURES AND REFRACTURES OF THE PATELLA.

BY EDRED M. CORNER, M.C.,

OF LONDON,

Surgeon to Out-patients and the Surgical Isolation Wards; Lecturer on Practical Surgery to St. Thomas's Hospital; Surgeon to the Children's Hospital, Great Ormond Street.

THESE figures were compiled from the hospital annals for the purpose of a lecture.[1] As no similar figures have been adduced, it has been thought worthy to place them upon permanent record. The most important points which they show may be summarized as follows:

1. Fractures in the lower half of the patella are the most frequent, 83 per cent.

2. Triangular shaped patellæ are the most common; oblique shaped patellæ come next.

3. Transverse fractures are the most frequent; comminuted fractures come next.

4. Three males fracture their patella to one female.

5. Fractures of the right patella are a little more frequent than of the left.

6. Two underwent operation to every one which did not.

7. Fracture of the patella is most frequent between the ages of 30 to 40.

8. The patella is the most frequently refractured bone in the body.

9. After operation, 69 per cent. of refractures occur in the first year after the injury.

10. After treatment other than operation, 86 per cent. of refractures occur after the first year.

11. The percentage frequent of refractures is approximately the same after operative as it is after non-operative treatment.

---

[1] Delivered at the Policlinic.

12. The advantages of operation are solely in the quick and complete recovery of the function of the limb.

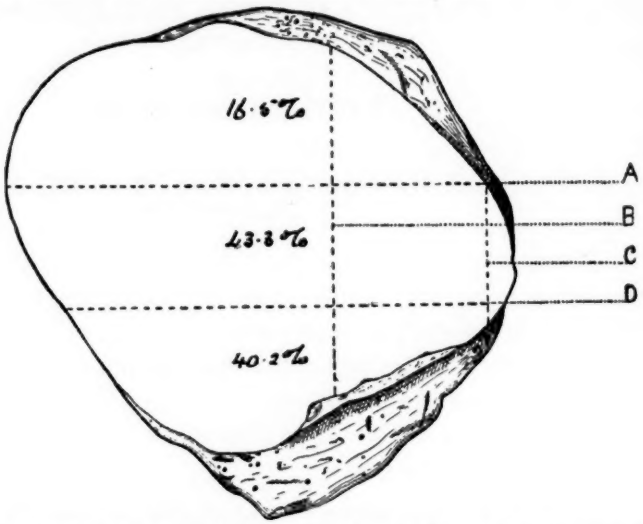


Diagram of the facets on the articular surface of the patella. *A* is the line marking the lower limit of the area in contact with the femur with full flexion of the knee. *D* is the line marking the upper limit of the area in contact with the femur in extension and slight flexion of the knee. *B* marks the division of the articular surface into right and left parts. *C* delimits the small area which is always in contact with the femur in all positions of the joint. The figures denote the percentages of fractures found in each area (see first table of figures).

STATISTICS OF CASES OF FRACTURE OF THE PATELLA ADMITTED TO ST. THOMAS'S HOSPITAL, 1890–1907 INCLUSIVELY.

Total number of cases, 504.

Fracture in lower part of bone	40.2	per cent.
Fracture about centre of bone	43.3	per cent.
Fracture in upper part of bone	16.5	per cent.
Fractures in lower part of bone	83.5	per cent.
Triangular shaped patellæ	66	per cent.[3]
Oblique shaped patellæ	20	per cent.
Elliptical shaped patellæ	9	per cent.
Circular shaped patellæ	5	per cent.
Transverse fractures	85	per cent.
Oblique fractures	4	per cent.
Comminuted fractures	10	per cent.
Compound fractures	1	per cent.

[3] Proceeding of Anatomical Society, February, 1900, pp. xxvii and xxviii.

In male subjects	73	per cent.
In female subjects	27	per cent.
On right side	55	per cent.
On left side	44	per cent.
Bilateral	1	per cent.
Patella sutured	65	per cent.
Treated by splints and massage	35	per cent.

Earliest period of life in which fracture occurred....between 5–10 years.
Period at which fracture occurs most frequently....between 30–40 years.
Next period at which fracture occurs most frequently.between 40–50 years.
Latest period in which fracture occurred.....between 70–80 years.

STATISTICS OF REFRACTURE OF THE PATELLA.

Total number of cases, 55.

Frequency of refracture	11	per cent.
Frequency of fracture of other patella	1	per cent.
Frequency of refracture after suture of the fragments	10	per cent.
Frequency of refracture after other treatment	9	per cent.
In male subjects	84	per cent.
In female subjects	16	per cent.
Of right patella	56	per cent.
Of left patella	44	per cent.
Bone twice fractured	85	per cent.
Bone three times fractured	9	per cent.
Bone four times fractured	6	per cent.
Compound refractures	7	per cent.
After suture, percentage of refractures within the first year	69	per cent.
After the first year	31	per cent.
After the first 3 years	12	per cent.
Within the first 3 years	88	per cent.
After other treatment, percentage of refractures within the first year	14	per cent.
After the first year	86	per cent.
Refracture occurring through the same place as the former fracture	95	per cent.

Otherwise the refracture is above the line of the original fracture.

TRANSACTIONS
OF THE
NEW YORK ACADEMY OF SURGERY.

Stated Meeting, held May 11, 1910.

The President, Dr. Ellsworth Eliot, Jr., in the Chair.

THREE CONSECUTIVE TRANSFUSIONS FOR PROFOUND SECONDARY ANÆMIA.

Dr. E. H. Pool presented a woman, 43 years old, who was admitted to the French Hospital on December 29, 1909. The following were the significant points of her history: Two weeks before admission she had suffered from violent headaches, pain in the back, and extreme weakness; a day later, slight jaundice appeared. She was confined to bed from the onset of her illness, growing steadily worse. For a number of years past she had at times suffered from a distressing cough and dyspnœa. Eighteen months ago she began to lose color, and this pallor had gradually become more pronounced. Menstruation had always been profuse, making her weak for some time following; the menorrhagia had been especially marked recently. She had two children, living and well; no miscarriages. Her habits were good.

Physical examination on admission: The patient was aroused with difficulty. Her mucous membranes were colorless, the lips dry, parched and brown; the conjunctivæ were slightly yellow; the skin had a lemon tint and was bloodless. The radial pulse was imperceptible and the heart sounds were very feeble. The woman appeared to be moribund. A blood examination showed 600,000 red blood-cells and 16 per cent. hæmoglobin. The urine contained a trace of albumin, abundant red blood-cells, a few leucocytes and hyaline and granular casts.

Transfusion by the Carrel suture method was immediately done, taking the woman's husband as donor, although he was weak and anæmic, his hæmoglobin being 70 per cent. Following

this there was some improvement in her condition, but the hæmoglobin rose only to 22 per cent. Blood examination that evening and on several subsequent occasions suggested pernicious anæmia.

The next day a second transfusion was made, taking a young man as donor. This was followed by marked improvement. The patient's cheeks became flushed, and her lips resumed a normal color. She, however, became extremely restless, and it was necessary to stop. During this transfusion, the patient's hæmoglobin rose to 33 per cent., and the number of red cells to 2,000,000. Afterwards she became delirious and two days later showed extreme jaundice.

Ten days later a third transfusion was done, as the patient's blood and general condition showed a marked tendency to become worse. A healthy young man was taken as the donor. Considerable and prolonged improvement followed this operation, the hæmoglobin rising from 23 per cent. to 56 per cent. during the transfusion.

After the third transfusion, the patient's blood continued to improve, although she developed a pneumonia in the right lower lobe, and subsequently pleurisy with effusion on the left side. Dr. N. B. Potter took charge of the patient during this illness, and made sixteen aspirations, removing from 20 to 30 ounces of clear or blood-tinged fluid each time.

The patient was now in good health, with 70 per cent. of hæmoglobin and over 3,000,000 red blood-cells. The blood examination was otherwise negative; the urine contained a trace of albumin.

According to Dr. Potter and Dr. F. C. Wood, the blood picture was not one of typical pernicious anæmia, but rather of very marked secondary anæmia, with a persistently high color index.

CARCINOMA OF AN ACCESSORY THYROID.

Dr. Pool presented a woman, 46 years old, who was admitted to the service of Dr. Frank Hartley, at the New York Hospital, on April 8, 1910. Three years ago she first noticed a small lump on the left side of the neck which had gradually increased in size. It was never painful. Last summer she began to have stinging pains of great severity in the left shoulder, and recently these pains had extended to the left arm. They had gradually been growing more severe, and three days before admission she

began to have constant pains of the same character in her left hand and wrist. She had lost about thirty pounds in weight in the past year.

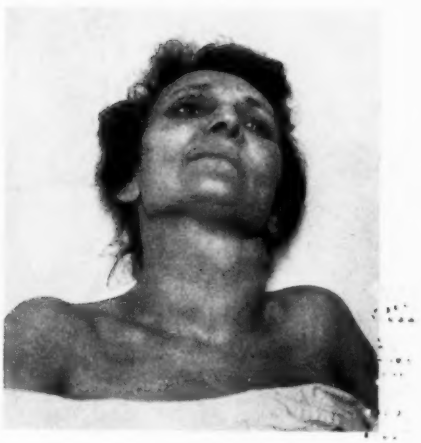
Physical examination: The patient was a well-developed woman. She complained of slight stiffness and pain on moving the neck. On the left side, corresponding approximately to the lower two-thirds of the sternomastoid muscle, there was a swelling about three and a half inches in diameter. The skin covering this was movable and normal in appearance. The swelling, which lay in part beneath the sternomastoid muscle, was hard, slightly nodular, and somewhat movable, but did not move during deglutition (Fig. 1). The pulsation of a large vessel could be felt mesial to its upper limit. In the left arm, the grip was relatively weak, but there was no paralysis nor anæsthesia. Eyes, respiration, voice and deglutition were normal.

Operation, by Dr. Frank Hartley: The mass was exposed by an incision along the anterior margin of the sternomastoid. The internal jugular crossed it vertically, and was ligated above and below; the omohyoid also crossed it, and was cut. The mass was then readily enucleated, after ligating several large nutrient vessels. The carotid lay posterior to the growth, the sternohyoid and sternothyroid mesial. On lifting these, the whole of an apparently normal thyroid gland, with isthmus and pyramidal lobe, was exposed. The patient made an uneventful operative recovery.

Report of specimen, made by Dr. Elser, Pathologist to the New York Hospital. The specimen consisted of an aberrant thyroid gland, oval in shape, measuring 9.5 cm. in length, 5.5 cm. in breadth and 5 cm. in thickness. The mass was covered on the outside by filmy connective-tissue membrane, through which numerous large, vascular channels were dispersed. Projecting beneath this capsule were many irregularly outlined, yellowish nodules. The mass was quite firm in consistence. On section, the cut surface was diffusely brownish-yellow in color, and irregularly lobulated. At one pole of the mass was a large area of necrosis. The specimen was accompanied by half a dozen enlarged lymph-nodes; most of these were yellowish-brown in color and were surrounded on the outside by connective-tissue capsules. On section, the cut surface was moderately granular, yellowish in color and elastic in consistence.

Microscopical examination of the accessory thyroid revealed the typical histology and papillary adenocarcinoma. Microscopical examination of the lymph-nodes revealed extensive metastatic deposits. Practically all the lymphoid tissue had been replaced by tumor growth.

FIG. 1.



Carcinoma of accessory thyroid.

PARTIAL THYROIDECTOMY FOR EXOPHTHALMIC GOITRE.

DR. WILLY MEYER presented a man, 36 years old, who came to the German Hospital early in 1910 with all the signs of typical exophthalmic goitre, and gave a history which dated back five years. During the past eighteen months his symptoms had become more pronounced; there was dizziness, rapid pulse and marked exophthalmus. He was first treated with the serum prepared by Merck, antithyroidin, in comparatively large doses. A week or ten days later the entire thyroid gland was exposed through a transverse incision, with the intention of removing the right lobe. There was still profuse hemorrhage after the right thyroid arteries had been tied; this was immediately checked after crushing and ligation of the isthmus, which was much enlarged. About one-third of the gland was left.

The patient made a rapid recovery, and a few weeks after the operation it was found that his pulse had materially improved, the exophthalmus was less pronounced and his other symptoms had disappeared. His highest temperature following the operation was 102.8, and this rapidly subsided.

CASES ILLUSTRATING THE EFFECT OF ARTIFICIAL ARTERIAL HYPERÆMIA IN THREATENING GANGRENE OF THE FOOT, DUE TO DIABETIC ENDARTERITIS.

DR. WILLY MEYER showed these cases. The first patient was a man, 60 years old, diabetic, on whom he did an amputation of the thigh in January, 1907, for dry, rapidly spreading gangrene of the toes and foot. The operation was done under spinal anæsthesia, and with secondary suture of the wound.

About a year and a half later this patient began to show evidences of beginning gangrene of the opposite foot; several toes became affected, and as the man absolutely refused further operative interference, it was decided to try artificial arterial hyperæmia. A suitable hot air apparatus was thereupon provided, and under this method of treatment, which had been faithfully carried out since, the gangrenous process affecting his remaining foot had been overcome. Not one part of the toes necrosed. Two apparatuses were used, alternatingly daily, one for the thigh and leg with high temperatures, the other for the affected foot with lower

temperatures, inasmuch as the affected part cannot stand great heat.

Dr. Meyer's second patient was a man, also 60 years old. The case was one of beginning diabetic gangrene involving the toes of both feet, with some œdema and threatening pains that indicated an extension of the process. A properly fitting hot air apparatus was provided, in which the upper and lower portions of the extremities were alternately exposed to a very high temperature. The result of this treatment was beyond expectations. The threatening gangrene failed to extend, the bluish discoloration of the toes disappeared, the patient had remained in comparatively good health and was able to go about without the aid of a stick or other support. He had now been using this apparatus daily for the past seven months, and the treatment was still being faithfully carried out.

As a matter of fact, this treatment will be successful in a certain number of cases only. Still it means an addition to our therapeutic resources, and deserves further trial. It is not indicated in the moist form of gangrene.

He had tried it also in two cases of Raynaud's disease. In one it had a temporary effect only, in the other none at all.

Dr. Howard Lilienthal said that the results of the hot-air treatment in these cases were certainly wonderful, and personally he had never seen anything like it. He inquired whether in the last case shown there was any pulsation in the posterior tibial, and also how long these patients continued the exposure to the hot air at each session. Also, what sort of apparatus he had been using, and how long he would advise the continuance of the treatment? The first case was apparently one of thrombo-angitis obliterans, in which the speaker said he had always advised amputation, whether the gangrene was of the dry form or not.

Dr. Meyer said that both the patients were diabetics. The hot-air exposures were at first limited to a fraction of one hour at each sitting, but the time was gradually lengthened to a whole hour daily. For the purpose of heating the apparatus, electricity was much superior to the Bunsen burner, as with the former there was no odor and there was no danger of fire or explosion. He warned against the use of alcohol as a means of heating the apparatus, and he recalled one case at the German Hospital where the alcohol lamp had set fire to the blankets covering the leg.

The treatment should be continued by the patients themselves—perhaps with longer or shorter intermissions—as long as they lived.

THE FIRST CASE OF THORACOTOMY IN A HUMAN BEING UNDER ANÆSTHESIA BY INTRATRACHEAL INSUFFLATION.

DR. HOWARD LILIENTHAL presented this patient, with full description of his condition, for which see ANNALS OF SURGERY for July, page 30.

CLINICAL EXPERIENCE WITH INTRATRACHEAL INSUFFLATION (MELTZER), WITH REMARKS UPON THE VALUE OF THE METHOD FOR THORACIC SURGERY.

DR. CHARLES A. ELSBERG read a paper with the above title, for which see ANNALS OF SURGERY for July, page 23.

DR. WILLY MEYER said that he was firmly convinced that in the course of time we would not depend on any single method in the performance of intrathoracic operations, and if this apparatus for intratracheal insufflation, which was less expensive than the differential pressure cabinets, was shown to work as well in human beings as in animals, we could look forward to its more general employment with much satisfaction as an addition to our mechanical resources in thoracic operations. The differential pressure cabinet and chamber had its field of usefulness in the large hospitals, where no doubt intrathoracic surgery would soon be undertaken by many surgeons.

Dr. Meyer said he had several times occasion to go deeply into the literature of thoracic surgery, and he had found that in 1896 Professor Tuffier, of Paris, had introduced a metal tube through the larynx deep into the trachea for anæsthesia, compressed the trachea above with a special clamp, and in this manner succeeded in narcotizing a patient and successfully doing a resection of the lung. This seemed to be the first case of intratracheal anæsthesia in the human. It was surprising that Tuffier did not continue his successful experiments. Two years later, Dr. Parham, of New Orleans, an associate of Dr. Matas, did a resection of the chest wall for the removal of a malignant growth. To anæsthetize the patient, he employed a Fell-O'Dwyer tube of a special conformation and just long enough to dip into the

trachea. By this means he successfully removed the growth. Here also intratracheal anæsthesia was helpful in completing the operation.

Regarding the patient presented by Dr. Lilienthal, he suggested that some artificial pneumothorax was left unintentionally when closing the thorax. The air in the pleural cavity first compressed the lung and reduced the size of the abscess cavity or cavities. With increasing absorption and attenuation of the component gases of the air the cavities again distended and the cough with expectoration returned.

DR. S. J. MELTZER said that in his earlier experiments with the intratracheal insufflation method the pressure of the air current before entering the trachea was, as Dr. Elsberg had pointed out, limited to a variation from ten to twenty mm. of mercury, but his more recent investigations had shown that the degree of this pressure had very little significance so long as the intratracheal tube was not too large to permit the free return of air. For example, it was found that an external pressure of 25 mm. produced in the trachea and bronchi a pressure of only 5 mm., and that a sudden increase of the external pressure to 50 mm. raised the pressures of the bronchi and trachea only 1 mm. of mercury.

This method of intratracheal insufflation, Dr. Meltzer said, was now being experimented with as a means of saving life in strychnine poisoning. In control experiments it was established that four-tenths of a milligramme of strychnine given to a dog by intravenous injection resulted fatally within 45 minutes. Eighteen dogs, which received eight-tenths of a milligramme of strychnine by intravenous injection, that is, twice the fatal dose, were kept alive and completely recovered by the aid of the intratracheal insufflation, which was kept up continuously in some cases as long as eight or nine hours. The convulsive movements were controlled by curarin and injections of Ringer solution were given to hasten the elimination of the strychnine by the kidneys. At the subsequent autopsies of these animals, there was not the slightest evidence of an injury to the trachea or lungs.

DR. N. W. GREEN thought that Dr. Meltzer deserved especial credit for developing this method of intratracheal insufflation for intrathoracic work, for which so many other similar methods had been ineffectually tried. In this connection, it may be inter-

esting to note that a case was reported by Chaussier in 1781, in which he used an intralaryngeal canula to resuscitate a young man said to have been in the last stages of phthisis. This case was reported before the Royal Society of Medicine, Paris.

DR. LILIENTHAL said that in the case of thoracotomy he had reported, while there were quite a number of adhesions between the visceral and parietal pleuræ, these did not impede the motions of the lungs to the slightest degree. He had made no attempt to loosen these adhesions. The lung was blown up to its fullest capacity before closing the chest, and the wound was then covered with moistened gauze.

DR. ELSBERG, in closing the discussion, emphasized the fact that the method of Dr. Meltzer differed absolutely in principle from that of the previous intratracheal methods. All of the methods that had been formerly advocated consisted essentially of the introduction of a tube into the trachea, which closed about the tube. By Dr. Meltzer's method, the tube was introduced almost down to the bifurcation, and it was so small that it permitted the free escape of air. With this method, it made no difference whether the patient breathed or not, whereas with the positive or negative cabinet it was very essential that the patient should not stop breathing.

BOOK REVIEWS.

DISEASES OF THE STOMACH AND INTESTINES. By ROBERT COLEMAN KEMP, M.D., Professor of Gastro-intestinal Diseases in the New York School of Clinical Medicine. 8vo, pages 710, illustrations 280. W. B. Saunders Company, Philadelphia and London, 1910.

The study of gastro-intestinal diseases is at the present date in an active transitional state. This is due mainly to the fact that in some instances, lamentably few we must confess, the clinician is confirming his diagnosis through means of the surgeon and the living pathology of the operating table. This is much more important in its results, both immediate and remote, as far as the welfare of the patient is concerned, than that information which we have hitherto acquired through the agency of the post-mortem.

What, then, have been the results? The answer is short, but yet revolutionary in its significance. Briefly it indicates that chapter after chapter of books which we have heretofore accepted as standard must be so altered and revised that the identity of the old ones will be completely lost. The treatise on diseases of the stomach in the future will decrease rather than increase in volume. What is needed and what will be produced is a work on *practical gastro-enterology*.

Can the general practitioner, or indeed the stomach specialist, be made to appreciate that in a thousand consecutive cases applying to him for relief of gastric symptoms, in less than 10 per cent. will the trouble be found in the stomach? In the other nine hundred cases he must look for, identify, and treat the etiologic factor, he must minister to the house that is burning, and not to the central station from which the alarm was sent out.

The author prefaces the present volume by remarking that in view of the excellent works on diseases of the stomach and intestines already placed before the profession, a new book on these subjects might seem superfluous. In considering the above facts and the large experience of the author, such a conclusion,

I am sure, will not be reached by his colleagues. The book considers so many phases of subjects which form the borderland between medicine and surgery, that it is alike of extreme interest to both practitioner and surgeon.

Its general scope covers all of the disorders, both subjectively and objectively, which one is liable to meet. The author is definite in stating his own conclusions, but does not belittle others by omitting them, leaving the question in many instances to the reader to draw his own inferences. The specific treatment and general management of the various conditions are thoroughly indicated.

Critically considered, we deplore the introduction of such illustrations as Turck's gyromele, Einhorn's radiodiaphane, the stomach whistle, and similar apparatus, with their accompanying text. Their uselessness, if not danger, has long since been demonstrated, and I am sure the value of the book would not be lessened by their being omitted.

In general, the author has brought up to date the knowledge of the subject as prescribed by the field indicated in the title, and as a record of personal experience and contemporary achievement will form an addition to our appreciation of the realms of gastro-enterology.

FRACTURES AND DISLOCATIONS. By LEWIS A. STIMSON, B.A., M.D., Professor of Surgery in Cornell University Medical College, New York. Sixth edition, thoroughly revised. Octavo, 876 pages, with 361 engravings and 65 plates. Lea and Febiger, Philadelphia and New York, 1910.

This treatise, which is now in its sixth edition, has been repeatedly reviewed in the ANNALS OF SURGERY, and it is not necessary to mention again the character of the work. The present edition is encyclopædic in its scope as far as fractures and dislocations are concerned, and cosmopolitan in the knowledge presented, owing to the inclusion of the accepted views of specialists throughout the world.

In this edition the author has enlarged our knowledge principally as regards the injuries of the small bones of the carpus and tarsus, and includes a new subhead, "The Midcarpal Frac-

ture-dislocations," the recognition of which has come mainly through investigations stimulated and aided by X-ray examinations. Sections have also been added on fractures of the floor of the acetabulum and of the internal epicondyle of the femur, and on backward dislocation of the lower jaw. Other additions of importance relate to treatment. Under this subject we find no reference made to the employment of metal plates for the correction of deformities in the long bones, as advocated by Lane.

Although the medical practitioner is loath to assume the responsibility of a complicated fracture, those who are situated far from the great centres must assume this responsibility, however limited may be their experience. To these men this book especially appeals as being a most complete, conscientious, and satisfactory treatise.

JAMES T. PILCHER.

CORRESPONDENCE.

ALBA'S OPERATION.

IN the report of the proceedings of the New York Surgical Society in the ANNALS OF SURGERY, vol. lii, No. 6, pages 938, 939, in describing the operation for rheumatoid arthritis of the hip the text calls it "Abbe's operation." It should be Alba's (Dr. F. H. Alba).

H. M. LYLE.

TO CONTRIBUTORS AND SUBSCRIBERS:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittance for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS OF SURGERY,
227–231 South Sixth Street,
Philadelphia.